SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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FRIDAY, JULY 12, 1901.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE CARNEGIE TECHNICAL UNIVERSITY.

IT was some weeks ago announced by the daily press as definitely settled that Pittsburg is to have a great technical institution, especially adapted to its peculiar needs and to be made, in its industrial field, as complete and admirable as the Carnegie Institute of that city has become in art and æsthetics. Mr. Carnegie, who has now placed the Scotch universities in a comparatively comfortable position by an endowment of ten millions of dollars, and has thus contributed to the cause of liberal education more than has ever been before given by any individual in a single gift, has now determined to do something on a liberal scale for that department which most naturally appeals to his personal sympathies—education in applied sciences—and he has agreed to supply the funds for the new foundation. The organization of the institution has been entrusted to the local Board of Trustees, already having charge of the Carnegie Institute and the Carnegie Library at Pittsburg. This body has appointed a committee 'On Plan and Scope' and this committee, in turn, has called in experienced and expert advisers to aid them

in determining upon the very best plan and the most suitable scope of the institution, and of its curriculum.

These expert advisers were Dr. R. H. Thurston, Director of Sibley College, Cornell University, Professor J. B. Johnson, Dean of the College of Engineering, University of Wisconsin, Professor Thomas Gray of the Rose Polytechnic School and Professor V. C. Alderson of the Armour Institute. After their several reports had been made, they were organized into a committee to consider and report upon the schemes of the individual reports and to present a final and condensed statement of the plan upon which all could agree. This is the report which we present herewith to the readers of SCIENCE. It includes, as is seen, three different and distinct forms of school which may be combined as parts of one complete technical university that might satisfy the ambition of John Scott Russell, were that greatest of promoters of industrial education living; or they may be adopted, singly or together, on any scale which the needs of the city, the opportunities of the founder and the ambition of Mr. Carnegie and his coadjutors may seem to justify.

It is understood that this is simply a recommendation of his committees and that Mr. Carnegie is in no way bound to accept either the plan, the scope or the estimated endowment as binding upon him. It is understood that the committees will report to him the plan and scope proposed for these schools, leaving him free to found a school for artisans, a technical high school or a technical college, or, if his ambition mounts so high, a true *technical university*, including them all, and more complete and universally fruitful of good to all sorts and conditions of men and women—it is understood that both sexes are to be provided for—than has been any institution for technical, industrial and scientific education, ever before conceived. Even this latter is entirely within the means of Mr. Carnegie, as limited by his publicly declared plans of distribution of funds for educational purposes, and it would be a glorious thing for the world, as well as for Pittsburg and our country, could the ideal technical university be thus made a reality by our greatest philanthropist.

REPORT OF THE ADVISORY COMMITTEE ON THE CARNEGIE TECHNICAL SCHOOLS OF PITTSBURG.

PITTSBURG, PA., June 25, 1901.

Mr. William McConway, Chairman Committee on Plan and Scope.

DEAR SIR.—Your Advisory Committee begs leave to submit the following report upon the scope of the proposed Carnegie Schools of Technology.

INTRODUCTION.

It has become clear, both to educators and to business men, that the new century demands a wide dissemination of a *new type of school training*. The new methods of concentrated capital and of wholesale production; the ready means of transport by which our antipodes have become both our customers and our sources of supply; the practical abandonment of both the apprenticeship system and of the individual manufacturer; the world-wide field of operations in all lines of trade; the infinite number of applications of scientific knowledge in all fields of modern industry; the whole-world competition which confines success to the most economic production;

and the constant supplanting of manual labor and man power by automatic machinery and by steam or electric power; these are some of the signs of the times by which it is clear that some new kind of preparation for the work of life must be introduced into the school training of both boys and girls. This, too, not only for their individual success, but for the maintenance of American leadership in manufacturing and commerce. What this new education should be for America may be exemplified by the proposed Carnegie Technical Schools of Pittsburg. Nothing short of such a complete system should be planned.

The scheme which your committee proposes may be divided as follows:

I. The Carnegie Technical College.
II. The Carnegie Technical High School.
III. The Carnegie Artisan Day and Evening Classes.

I. THE CARNEGIE TECHNICAL COLLEGE.

This should be a first-grade technical college, superposed upon a high-school curriculum, with entrance requirements equal to those demanded by the best grade of existing colleges of engineering. It should be a school of both pure and applied science, and should prepare young men for leadership in the commercial as well as in the industrial pursuits. Both our manufacturing industries and our foreign commerce are now demanding the highest technical training it is possible to bestow, but this training must be fitted to particular vocations.

This college should be made attractive to the greatest scholars in the fields of physical and chemical science. To obtain and hold such men they must be given ample opportunities for research. This college must be supplied, therefore, not only with great experimental shops and laboratories for students' use, but in all departments there should be splendidly equipped laboratories of investigation and research, under the direction of the head of such department, and with a full corps of assistants for the carrying on of lines of investigation which are now partly or wholly unprovided for in America. These well-equipped workshops and these experimental and research laboratories would form the chief distinction of this technical college, and they would also be the chief item of expense. This college would support one or more publications in which the fruits of this research department would be given freely to the world. While the number of students in this college would be small, as compared with the number in the technical high school, the work done here would be of far more benefit to the world, and it would form the chief, if not the only, feature of the whole scheme to attract attention and to extend its beneficent influences beyond the immediate vicinity of Pittsburg.

Instruction in the Technical College should include:

1. Technical courses in—
   - *a.* Mechanical engineering.
   - *b.* Electrical engineering.
   - *c.* Civil engineering.
   - *d.* Chemical engineering.
   - *e.* Electro-chemical engineering.
   - *f.* Marine engineering.
   - *g.* Railway engineering.
   - *h.* Sanitary engineering.
   - *i.* Mining engineering and metallurgy.
   - *j.* Architecture.
   - *k.* Commerce and transportation.
2. Courses in pure and applied sciences.
   - *a.* Mathematics.
   - *b.* Physics.
   - *c.* Chemistry.
   - *d.* Biology..
   - *e.* Geology.
   - *f.* Mineralogy.
   - *g.* Astronomy.
   - *h.* Economics.
   - *i.* Commercial geography.
3. Courses in modern languages.
   - *a.* English.

b. German.
c. Spanish.
d. French.

II.—THE CARNEGIE TECHNICAL HIGH SCHOOL.

The work of this school should be superposed upon the work of the public grammar schools of Pittsburg and Allegheny. Its scope should be broad and comprehensive. The elective principle should be recognized, and graduation would depend not upon completing a prescribed curriculum, but upon completing a required number of courses, to be selected by the student under the direction of the director of the school.

In this school, the boy who wished to fit himself for industrial pursuits would find equal advantages with the boy who desired to prepare himself for professional engineering, or the girl who wished a general high school education supplemented by instruction in the home-making arts.

To make this instruction practical and fruitful of results it would be necessary to have well-equipped shops and experimental laboratories in all the courses leading toward specific employments, and these require a liberal housing, an expensive equipment and an expert direction by accomplished artisans. Such a complete school as is here proposed does not now exist in this country, but it would prove a pattern to be copied in every large city and such as the new century and the new industrial conditions demand.

Instructions should include:

1. The ordinary English high-school studies.
2. Physics, chemistry and biology, with students' laboratory practice.
3. The elements of the calculus and applied mechanics.
4. French, German and Spanish.
5. Commercial studies.
6. Domestic arts and sciences.
7. Freehand and mechanical drawing.
8. Technical studies, fitting for the industries of the locality, such as:

a. Blast furnace and foundry practice.
b. Glass-making.
c. Brass-founding and finishing.
d. Pattern-making and joinery.
e. Metal-working.
f. Stationary, locomotive and marine engine and boiler management.
g. Light and power station management.
h. Gas manufacture.
i. Railroad transportation.
j. Plumbing and domestic sanitation.
k. Surveying.
l. Clay working and ceramics.
m. Industrial art.

III.—THE CARNEGIE DAY AND EVENING CLASSES.

These classes are proposed for the benefit of those who are unable to take advantage of the more complete courses in the Technical High School. They should be available to both sexes. Instructions should include:

a. Elementary mathematics.
b. Elementary physics.
c. Elementary mechanics.
d. Elementary chemistry.
e. Freehand and mechanical drawing.
f. Modern languages and elementary instruction in such technical subjects as are taught in the Technical High School.
g. Courses of special lectures on subjects of interest to artisan classes.

In conclusion your committee desires to state that in its judgment a large tract of land, not less than 50 or 60 acres in extent, should be provided, in order that the buildings may be grouped about an attractive campus.

Furthermore, the best educational experience leads us to believe that the highest interests of these schools will be conserved by being maintained as independent insti-

tutions unhampered by public or private control.

Respectfully submitted,

(Signed) ROBERT H. THURSTON,
VICTOR C. ALDERSON,
THOMAS GRAY,
J. B. JOHNSON.

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*A NATIONAL UNIVERSITY.**

To the National Council of Education:

The undersigned members of the committee to investigate the entire subject of a national university and to report to the Council do now report, as follows:

The appointment of the committee was authorized by the Council at their meeting at Washington, D. C., on July 11, 1898, in the passage of the following resolution, offered by Mr. Dougherty, of Illinois:

Resolved, That the chair appoint a committee of fifteen, the majority of whom shall be members of the Council, who shall investigate the entire subject of the establishment of a national university and report to the Council.

MEMBERSHIP.

The president of the Council subsequently appointed the committee, as follows:

WILLIAM R. HARPER (*chairman*), president of the University of Chicago.

EDWIN A. ALDERMAN, president of the University of North Carolina (now president of Tulane University of Louisiana).

JAMES B. ANGELL, president of the University of Michigan.

NICHOLAS MURRAY BUTLER, professor of philosophy and education in Columbia University.

JAMES H. CANFIELD, president of Ohio State University (now librarian of Columbia University).

J. L. M. CURRY, agent of the Peabody and Slater educational funds.

NEWTON C. DOUGHERTY, superintendent of schools, Peoria, Ill.

ANDREW S. DRAPER, president of the University of Illinois.

CHARLES W. ELIOT, president of Harvard University.

EDMUND J. JAMES, professor of public administration in the University of Chicago.

WILLIAM H. MAXWELL, superintendent of schools, New York, N. Y.

BERNARD J. MOSES, professor of history and political economy in the University of California.

J. G. SCHURMAN, president of Cornell University.

F. LOUIS SOLDAN, superintendent of schools, St. Louis, Mo.

WILLIAM L. WILSON, president of Washington and Lee University.

*Report of the Committee of the National Educational Association.

MEETINGS.

The committee have held three protracted meetings: at Washington, D. C., on November 2, 3 and 4, 1899; at Chicago, Ill., on February 26, 27 and 28, 1900; and at New York, N. Y., on May 23 and 24, 1901. The first meeting of the committee was attended by all the members except Messrs. Angell, James (absent in Europe), and Moses. The second meeting was attended by Messrs. Harper, Alderman, Butler, Dougherty, Draper, Eliot and Soldan. The third meeting was attended by Messrs. Harper, Butler, Canfield, Dougherty, Draper, Eliot and Maxwell.

Mr. Moses has been absent from the country on public business, and so has been prevented from sharing in any of the deliberations of the committee. Mr. Wilson's untimely death in 1900 deprived the committee of the benefit of his cooperation in the preparation of this report.

PRELIMINARY INQUIRIES.

Before the committee came together for the first time, individual members had, at the request of the chairman, undertaken to prepare reports upon special phases of the subject referred to the committee, with a view to preparing the way for their more intelligent consideration and discussion. The reports so prepared included one by Mr. James, on the constitutionality of a national university (printed in the *Educational Review*, Vol. XVIII., pp. 451–66, December, 1899); one by Mr. Canfield, on past efforts to establish a national university and the reasons for their failure; two

by Mr. Butler, on bills to establish a national university pending before the Congress, and on the history of any funds and bequests toward the establishment of a national university, respectively; one by Mr. Harper, on the steps taken by the Association of Agricultural Colleges and Experiment Stations to secure provision for further study in the government departments at Washington by graduates of those institutions; two by Mr. Eliot, on the existing educational agencies at Washington which might be affected by any scheme for a national university, and on the number, variety, extent and character of the scientific or technical departments of governmental work which might properly be included in any scheme for a national university, respectively; one by Mr. Angell, on the probable attitude of the principal universities of the country toward the project to establish a national university; and one by Mr. Maxwell, on existing organizations which are interested in the establishment of a national university.

QUESTIONS STATED.

With the information contained in these reports before them, the committee proceeded to the consideration of the following questions:

1. Should there be established a statutory university of the United States?

2. (*a*) If the first question be answered in the affirmative, how should such university be established and governed, and what should be its scope and functions?

(*b*) If the first question be answered in the negative, should the Congress be asked to place the educational facilities of the government departments at the disposal of a non-governmental institution?

3. If the question 2 (*b*) be answered in the affirmative, should a plan be devised by which, through the cooperation of several institutions, such a non-governmental institution might be established and maintained at Washington, this to involve its incorporation and governmental aid?

ARGUMENT FOR A NATIONAL UNIVERSITY.

In considering the first question, the committee took into careful consideration the argument advanced in favor of a statutory university of the United States, which is usually presented in the following form:

1. Such a university is needed to complete and to crown the educational system of the United States.

2. Such a university is needed to supplement the resources of existing institutions and to offer opportunities for more advanced investigation and research than are now offered by the universities of the country.

3. Such a university was urged by Washington, and has been urged by many eminent statesmen since the foundation of the government, as desirable and necessary.

4. Such a university is needed in order to coordinate the scientific work now being carried on in the several government departments at Washington, and to put that work at the disposal of advanced and adequately trained students.

CRITICISM OF THIS ARGUMENT.

Waiving all questions of the constitutional power of the Congress to provide for a university of the United States, which power is held by Mr. James, in the report above referred to, to be fully established, the fourfold argument in favor of a national university suggests the following considerations and comments:

1. There is no educational system of the United States in the formal and legal sense in which there is an educational system of each of the several States, and therefore the contention that there should be a national university to serve the nation, as each of the State universities serves its

State and the State educational system, rests upon a false analogy. In a general and popular sense there is undoubtedly an American educational system, but it consists of institutions of three different types:

A. Those which the State establishes and maintains, such as the public schools and the state universities.

B. Those which the State authorizes, such as school and university corporations, private or semi-public in character, which gain their powers and privileges by charter, and which are often exempt in whole or in part from taxation.

C. Those which the State permits, such as private-venture (unincorporated) educational undertakings of various kinds.

Each of these classes is in a true sense national, in that it reflects and represents in part the way which the American people have followed in providing general education. No inventory of the nation's educational activity is complete that does not include them all. There are in existence at the present time a group of truly national universities, some of them of the State-authorized and some of the State-supported type, and in them the national ideals and the national temper are as truly revealed and realized as are those of Germany in Berlin and in Leipzig, those of England in Oxford and in Cambridge, and those of France in Paris and in Montpellier. The argument for a statutory national university based upon the hypothesis that there is now no national university in existence is only formally true; in fact, it is without foundation.

2. The argument that a statutory national university is needed to supplement the resources of existing institutions is based upon a misunderstanding of the facts. No one of the world's universities can possibly be supreme in all departments of intellectual activity; a statutory university of the United States could not be so. Conditions of time, place, special equipment and of individual scholarship all tend to make one university stronger in some one field of investigation than in others and to render it as unwise as it is impracticable for any one university to set before itself the hope of excelling in every branch of scholarship. The universities of the United States now offer ample opportunities for the most advanced research, and these opportunities in many departments are far in excess of the number of students wishing to avail of them. On the other hand, a university which should aim to hold mature and highly trained men indefinitely in the stage of learning without either producing or teaching would be a positive injury to the national life and character. The period of preparation for the active duties of life is already unduly prolonged.

3. An examination of the several passages in the speeches and writings of Washington that relate to a national university discloses the facts that the evil against which he wished a national university to guard has long since ceased to be possible, and that his plans and hopes have been realized with a completeness of which he never dreamed by the universities which have grown up in the United States. Washington's fear was that the youth of America, being forced to obtain their higher education in Europe, would not 'escape the danger of contracting principles unfavorable to republican government.' Obviously this fear has been utterly dispelled, and the universities that exist are far more complete and far more advanced than anything that could have been foreseen a century ago. There appears, therefore, to be no force in this phase of the argument for a statutory university at Washington.

4. That there are important opportunities for research of various kinds in connection with the government laboratories and collections at Washington is certain, and that

full advantage should be taken of these opportunities is greatly to be desired. This desire is confessed by the Congress itself in the joint resolution of April 12, 1892, to be referred to more fully hereafter, and is frequently expressed by the directors of the scientific work of the government. But it by no means follows that the only way, or indeed the best way, to make use of these opportunities is through the creation of a statutory, degree-conferring university. The objections to such an institution far outweigh any possible advantages which might follow from its establishment for the sole purpose of making fully effective the existing opportunities for higher instruction and research in connection with the government service, especially as it is possible to make these opportunities fully effective in what is in our judgment a simpler and a better way.

DECLARATION OF THE COMMITTEE.

The committee, therefore, by unanimous vote—twelve members being present and voting—adopted the following declaration on November 3, 1899:

1. *It has been and is one of the recognized functions of the federal government to encourage and aid, but not to control, the educational instrumentalities of the country.*

2. *No one of the bills heretofore brought before Congress to provide for the incorporation of a national university at Washington commends itself to the judgment of this committee as a practicable measure.*

3. *The government is not called upon to maintain at the capital a university in the ordinary sense of the term.*

ALTERNATIVE PLANS.

In this declaration the committee answered in the negative the first question under consideration, namely: Should there be established a statutory university of the United States?

The second question before the committee was: Should the Congress be asked to place the educational facilities of the government departments at the disposal of a non-governmental institution?

It appears from the public record that the Congress has already done this. There are two expressions of the will and the purpose of the Congress in this matter.

The first is contained in the joint resolution, approved April 12, 1892, which is as follows:

Joint resolution to encourage the establishment and endowment of institutions of learning at the national capital by defining the policy of the government with reference to the use of its literary and scientific collections by students:

WHEREAS, Large collections illustrative of the various arts and sciences, and facilitating literary and scientific research, have been accumulated by the action of Congress through a series of years at the national capital; and

WHEREAS, It was the original purpose of the government thereby to promote research and the diffusion of knowledge, and is now the settled policy and present practice of those charged with the care of these collections specially to encourage students who devote their time to the investigation and study of any branch of knowledge by allowing to them all proper use thereof; and

WHEREAS, It is represented that the enumeration of these facilities and the formal statement of this policy will encourage the establishment and endowment of institutions of learning at the seat of government, and promote the work of education by attracting students to avail themselves of the advantages aforesaid under the direction of competent instructors; therefore,

Resolved by the Senate and House of Representatives of the United States of America, in Congress assembled, That the facilities for research and illustration in the following and any other governmental collections now existing or hereafter to be established in the city of Washington for the promotion of knowledge shall be accessible, under such rules and restrictions as the officers in charge of each collection may prescribe, subject to such authority as is now or may hereafter be permitted by law, to the scientific investigators and to students of any institution of higher education now incorporated or hereafter to be incorporated under the laws of Congress or of the District of Columbia, to wit:

One. Of the Library of Congress.

Two. Of the National Museum.

Three. Of the Patent Office.
Four. Of the Bureau of Education.
Five. Of the Bureau of Ethnology.
Six. Of the Army Medical Museum.
Seven. Of the Department of Agriculture.
Eight. Of the Fish Commission.
Nine. Of the Botanic Gardens.
Ten. Of the Coast and Geodetic Survey.
Eleven. Of the Geological Survey.
Twelve. Of the Naval Observatory.
Approved, April 12, 1892.

The second is contained in the following paragraph in the general deficiency appropriation bill passed at the second session of the Fifty-sixth Congress, and approved March 3, 1901:

That facilities for study and research in the government departments, the Library of Congress, the National Museum, the Zoological Park, the Bureau of Ethnology, the Fish Commission, the Botanic Gardens, and similar institutions hereafter established shall be afforded to scientific investigators and to duly qualified individuals, students and graduates of institutions of learning in the several states and territories, as well as in the District of Columbia, under such rules and restrictions as the heads of the departments and bureaus mentioned may prescribe.

The joint resolution of April 12, 1892, placed the governmental facilities for research at the disposal of duly qualified students of institutions of learning at Washington, D. C. The law of March 3, 1901, extends the same privilege to duly qualified students or graduates of institutions of learning wherever they may be situated throughout the United States.

It appears, therefore, that the Congress has already taken the necessary steps to make possible all that is desired in this connection, and it only remains to devise a plan by which the advanced students who wish to avail of the opportunities offered may be given such systematic information, direction and oversight as they may need in order to carry on their studies to the best advantage, and in order that such official records of their work at Washington may be kept as will justify the several universities of the country in recognizing the period spent in study and investigation at Washington in passing upon their qualifications as candidates for the higher academic degrees.

A NON-GOVERNMENTAL INSTITUTION AT WASHINGTON.

The remaining question before the committee for consideration was, then, this: Should a plan be devised by which, through the cooperation of several institutions, such a non-governmental institution should be established and maintained at Washington, this to involve its incorporation and governmental aid.

The subject of the best form of organization for such an institution and of its precise relations to the government has been given prolonged consideration. Advice and suggestion have been sought from the heads of the several scientific bureaus at Washington, from the representatives of the Association of Agricultural Colleges and Experiment Stations, from the presidents of the State universities and land-grant colleges, and from many others believed or supposed to be interested in the question. It seemed at first as if a solution might be found through the Smithsonian Institution, and that it might most wisely undertake the advisory and supervisory functions for which provision was to be made. The authorities of the Smithsonian Institution, however, did not view the suggestion with favor, and, in addition, they were doubtful of their legal capacity to perform such functions. Another objection was found in the fact that the Smithsonian Institution restricts itself to the field of the natural sciences, whereas students of history, political economy, and philology are also to be provided for.

An alternative suggestion was that the Bureau of Education should be asked to assume executive control of the proposed

student body. On reflection, however, it appeared that this would require far-reaching amendments to the law governing the bureau, that these might be difficult or impossible to obtain, and that the matter might become complicated with wholly extraneous considerations relating to the status of the Bureau of Education and the extension of its authority in other directions.

It has, therefore, seemed best to the committee not to propose either of the plans above mentioned.

The committee have been advised, however, of a plan for a non-governmental institution at Washington, which may be able to supply all that is desired. This plan is the outcome of action taken by the Washington Academy of Sciences and by the George Washington Memorial Association.

WASHINGTON ACADEMY OF SCIENCES.

The Washington Academy of Sciences includes in its membership all, or nearly all, the directors and officers of the scientific bureaus of the government. It was organized in 1898 and grew out of the affiliation which had previously existed between the local scientific societies. It is an incorporated body having for its main object to bring within a single organization the representatives of the varied scientific work being carried on at the capital. The academy has power to acquire and to hold real estate, to publish, to conduct or to assist investigation in any department of science, to maintain a library, and in general to transact any business pertinent to an academy of sciences. The list of members, resident and non-resident, of the Washington Academy of Sciences shows that it is national in its scope and influence, and that representatives of philosophy, history, education and political economy are included.

GEORGE WASHINGTON MEMORIAL ASSOCIATION.

The George Washington Memorial Association is an organization of women, incorporated in the District of Columbia in 1898, "to advance and secure the establishment in the city of Washington, D. C., of a university, for the purposes, and with the objects, substantially as contemplated and set forth in, and by, the last will of George Washington, the first President of the United States of America, and to increase the opportunities for the higher education of the youth of the said United States, and to this end to collect, take and hold moneys, gifts and endowments, to take and to hold by purchase, donations, or devise, real estate, to erect and furnish buildings to be used by said university, when legally established," and so forth.

In the year 1901 the certificate of incorporation of the George Washington Memorial Association was amended in due legal form, and all mention of a university was omitted from the statement of its purposes. The object of the Association is now declared to be "to aid in securing in the city of Washington, D. C., the increase of opportunities for higher education, as recommended by George Washington, the first President of the United States of America, in his various messages to Congress, notably in the first, in favor of 'the promotion of science and literature,' and substantially as contemplated and set forth in the last will of George Washington, and by and through such other plans and methods as may be necessary and suitable for the objects and purposes herein set forth, and to this end to collect, take and hold moneys, gifts and endowments, to take by purchase, donation, or devise, real estate, and hold the same, to erect and furnish buildings to be used for the purposes herein set forth, and, when necessary for the said purposes, to sell, convey, mortgage and exchange any real and personal estate which the As-

sociation may hold, and to do any and all things which may lawfully be done in carrying out the objects and purposes of this corporation."

ACTION OF THESE ORGANIZATIONS.

It appears that action has been taken by these organizations—by the Board of Managers of the former on February 26, 1901, and by the Board of Trustees of the latter on March 13, 1901—which brings the support of each to a plan for an institution of the type which has been discussed above. Both organizations have agreed to cooperate to found an institution in the city of Washington, as a memorial to George Washington, which shall be maintained to promote the advanced study of the sciences and the liberal arts, and which shall assist in carrying out the purposes and the intent of the joint resolution of April 12, 1892, and of the law of March 3, 1901.

WASHINGTON MEMORIAL INSTITUTION.

On May 17, 1901, articles of incorporation were filed at Washington, D. C., signed by Daniel C. Gilman, president of the Johns Hopkins University; Charlotte Everett Hopkins, president of the George Washington Memorial Association; C. Hart Merriam, chief of the United States Biological Survey; George M. Sternberg, surgeon-general, United States army; Charles D. Wolcott, director of the United States Geological Survey; and Carroll D. Wright, United States Commissioner of Labor, as follows:

ARTICLES OF INCORPORATION.

WE, the undersigned, persons of full age, and citizens of the United States, and a majority of whom are citizens of the District of Columbia, being desirous to establish and maintain, in the city of Washington, an institution in memory of George Washington for promoting science and literature, do hereby associate ourselves as a body corporate, for said purpose, under the general incorporation acts of the Congress of the United States enacted for the District of Columbia; and we do hereby certify in pursuance of said acts as follows:

1. The name or title by which such institution shall be known in law is the Washington Memorial Institution.

2. The term for which said institution is organized is nine hundred and ninety-nine years.

3. The particular business and objects of the institution are: to create a memorial to George Washington; to promote science and literature; to provide opportunities and facilities for higher learning; and to facilitate the utilization of the scientific and other resources of the government for purposes of research and higher education.

4. The number of its trustees for the first year of its existence shall be fifteen.

Steps are to be taken at once by these incorporators to organize the institution, as described, and to select a body of trustees which shall be efficient and, so far as may be, representative of a variety of scientific and educational interests.

CHARACTERISTICS OF THE INSTITUTION PROPOSED.

Concerning the proposed institution, we assume:

1. That it will be independent of government support or control, as it will also be independent of the support or control of existing educational institutions. It might well appeal with peculiar force to the generosity of those men and women who are willing to increase, and who are desirous of increasing, the endowment of higher education in the United States.

2. That its objects will be:

a. To facilitate the use of the scientific and other resources of the government for research.

b. To cooperate with universities, colleges and individuals in securing to properly qualified persons opportunities for advanced study and research now obtainable only to a limited extent in Washington and not at all elsewhere.

3. That its oversight and control will be in the hands of trustees and officers representing the educational experience and ideals of the existing institutions for higher education.

4. That the arrangements between the student body and the several governmental bureaus will be made, subject to the by-laws of the trustees, in such a way as to carry out to the fullest possible extent the declared policy of the Congress. It is expected that the government officials will advise rather than instruct the students assigned to them.

5. That the sole test of admission to the privileges which the institution offers will be merit and proficiency, to be ascertained in such way as the trustees shall provide.

6. That students coming from universities and colleges for a period of study or investigation at Washington will, upon request, be given appropriate credentials, on completing their work, for presentation to the institution from which they seek a degree.

7. That students working in government laboratories or collections will be subject to the rules and regulations there prevailing.

PROVISION FOR STUDENTS.

	Possible instructors.	Maximum No. of students.
1. Animal industry	10	25
2. Anthropology and ethnology	4	13
3. Astronomy	3	8
4. Botany	11	25
5. Cartography	2	5
6. Chemistry	6	10
7. Forestry	10	20
8. Geology	10	17
9. History (Library of Congress)	5	10
10. History and diplomacy (State Department)	1	5
11. Hydrography	5	10
12. Library administration and methods (Library of Congress)	5	15
13. Magnetism	1	2
14. Meteorology	5	15
15. Mineral resources	2	5
16. Paleontology	5	7
17. Physics	2	3
18. Standards (Bureau of)	Now bei	ng org'd
19. Statistics	2	5
20. Tides	1	2
21. Topography	10	20
22. Zoology	34	50
	134	272

8. That, if successfully carried out, this plan will provide a body of trained students, ready for expert work, many of whom might enter the government service, while others would become instructors in institutions of learning or be engaged as experts in a private capacity.

The departments or subjects in which graduate students could be received and the provision that could be made for them at present are unofficially estimated to be as in previous table.

ACTION OF COMMITTEE.

The committee have adopted the following resolution:

Resolved, That we approve the plan for a non-governmental institution, known as the Washington Memorial Institution, to be established and maintained at Washington, D. C., for the purposes of promoting the study of science and the liberal arts at the national capital, and of exercising systematic oversight of the advanced study and investigation to be carried on by duly qualified students in the governmental laboratories and collections, in accordance with the terms of the joint resolution of Congress approved April 12, 1892, and those of the act of March 3, 1901.

We recommend that the National Council of Education adopt the following resolution:

Resolved, That the report of the committee authorized by resolution of July 11, 1898, to investigate the entire subject of a national university be received, and the committee discharged.

William R. Harper,
Chairman.
Edwin A. Alderman.
Nicholas Murray Butler.
James H. Canfield.
J. L. M. Curry.
Newton C. Dougherty.

ANDREW S. DRAPER.
CHARLES W. ELIOT.
WILLIAM H. MAXWELL.
J. G. SCHURMAN.
F. LOUIS SOLDAN.

NOTE.—Mr. E. J. James was unable to attend the meetings of the Committee and declines to sign the report.

May 24, 1901.

RADIO-ACTIVE SUBSTANCES AND THEIR RADIATIONS.

DURING the past five years many physicists, attracted by the freshness of the field and the promise of important discoveries, have turned their attention to the study of the newly discovered radio-active substances. The result has been a rapid increase in knowledge of and interest in the phenomena, until now the main facts are known to all scientists, but, since the knowledge of the subject is increasing so fast, a short review is now and then acceptable and necessary, especially to those whose chief interests lie along other lines. In this article an attempt is made to point out the more interesting features of the subject.

The real discovery of the persistent radiations from the uranium compounds was made by M. Henri Becquerel in 1896. It had been stated by M. Niewenglowski that under the action of sunlight certain phosphorescent salts emit radiations which can penetrate black paper. In testing whether this applies to uranium salts, M. Becquerel discovered to his surprise that with uranium salts exposure to sunlight is unnecessary; uranium compounds are all the time giving off radiations which can pass through opaque bodies and affect a photographic plate on the other side. It was soon found that the uranium radiations discharge electrified bodies in the neighborhood by ionizing the surrounding air after the manner of kathode and X-rays. Naturally, about the first hypothesis was that the radiations are ether vibrations, perhaps of very short wave-length, and many attempts were made to find evidence of reflection, refraction or polarization, with the result that none of these properties nor any of the properties peculiar to wave motion has yet been shown to belong to these radiations.

A few months after the discovery of the uranium radiations Professor Schmidt and Mme. Curie, a Polish physicist working in Paris, independently discovered the radio-activity of thorium compounds. An elaborate study of thorium radiations has since been made at McGill University by Professors Rutherford and Owens.

A greater discovery, however, was in store for Mme. Curie; for observing that many specimens of pitchblende, the principal ore of uranium, were more strongly radio-active than the pure uranium salts, she and her husband attempted a chemical separation of the suspected more active element. The result is well known; they succeeded in isolating two substances having at least 100,000 times the radio-activity of uranium. The first of these substances, which they named polonium, follows the bismuth in the separation from pitchblende. The separation from the bismuth is effected by taking advantage of the fact that polonium sulphide is more volatile than bismuth sulphide. The second substance they named radium. It follows the barium in its chemical reactions, but its chloride is less soluble in water than barium chloride, which affords a means of separation from the barium. Another very active substance has been obtained from pitchblende by M. Debierne. He has named it actinium. Chemically it is closely allied to titanium.

No one of these three substances has been obtained free from impurity, and the amounts obtained are exceedingly small, only a few centigrams from a thousand kilograms of pitchblende.

The spectrum of radium has been carefully examined by M. Demarcay, who assigns to it several new lines, the strongest having wave-lengths 4,683 and 3,814.7, and two bands. No characteristic spectrum has yet been found for polonium or actinium. On account of the small quantities of these substances available, no accurate atomic weight determinations have yet been made, but from what has been done it appears that radium has a higher atomic weight than barium.

At first it was supposed that the uranium itself was the source of the radio-activity of the uranium salts, since often the activity of the compounds seemed to depend on the amount of uranium present, but after the discovery of radium and polonium the radio-active power of uranium began to come under suspicion. Professor Crookes found that often different specimens of the same uranium salt would have very different radio-active strength, which difference in strength could be very little changed by changes in chemical or physical conditions, the strongly active salt remaining so and the less active salt never gaining strength. Suspecting that the radio-activity was due to something other than the uranium, Professor Crookes set about separating this irrepressible element. Such was his success that, starting with active uranium nitrate, he was able to obtain from it uranium nitrate which had no effect on a photographic plate even with an exposure of seven days. At the other end of the separation he had a substance many times as active as the original salt. The best and simplest of several methods of separation makes use of ether as a solvent. The ether dissolves the uranium nitrate and leaves undissolved most of the radio-active substance. This substance Professor Crookes calls UrX, the X testifying to our present ignorance of its real nature. Professor Crookes has also tried to separate the active material from the thorium compounds, but has so far met with only partial success. It seems not unlikely, though, that it may yet be done as completely as in the case of uranium. Meanwhile it is convenient still to speak of uranium and thorium radiations.

PHOTOGRAPHIC AND CHEMICAL EFFECTS OF THE RADIATIONS.

The photographic effect was the one first discovered and it remains the most delicate test for radio-activity, for the effect is cumulative, and the exposure may be made as long as desired. Any one can obtain very good radiographs from any of the ordinary uranium salts by using rapid dry-plates and an exposure of two days, while visible effects can be obtained with a much shorter exposure. Polonium and radium affect a photographic plate in a few minutes if sufficiently close to it. Even with a distance of a meter between the radium and the plate, radiographs have been obtained after a few days' exposure. These are very sharp, showing thus the rectilinear propagation of the radiations. Polonium radiations are so rapidly absorbed by the air that no effect is produced with a greater distance than a few centimeters.

Under the action of the radium radiations glass takes a permanent brown or violet tint. The haloid salts of the alkali metals become colored just as under the action of the X-rays. Paper is sometimes discolored and under certain conditions ozone may be formed in the neighborhood of the very active substances. Barium platino-cyanide is colored brown.

The action of the radium rays on the skin is the same as that of the X-rays. At first there is a slight reddening of the skin, but after three or four weeks' exposure severe inflammation sets in.

FLUORESCENCE.

Most of the substances that show fluorescence under the action of ultra-violet light or the X-rays also fluoresce under the action of the radium radiations, while those that fluoresce under ordinary light do not fluoresce under the radium radiations; but there are numerous exceptions to these rules.

It is a very interesting fact that when freshly prepared the radium salts are faintly self-luminous, and this property seems to be retained as long as the salt does not absorb moisture. It is this property that has excited much of the popular interest in the radium salts, for it is a case of the longed-for light without heat. In fact, it is light with no apparent source of energy whatever. If radium chloride ever becomes cheap we may be given an opportunity to court fortune by investing in preferred stock of some 'International Radium Illuminating Company.' Just at present gold is dirt cheap in comparison with these radium salts. The self-luminescence is due to the fact that under the action of its own rays either the salt itself, or some of the unavoidable impurities, fluoresces.

Some of the tissues of the eye fluoresce under the radium rays, so a sensation of light is felt when some of the salt is brought before the closed eyelids or placed on the temple.

IONIZATION OF GASES.

Any gas traversed by the Becquerel rays, as Mme. Curie has named the new radiations, is made capable of conducting electricity. This conductivity is of the same nature as that produced in gases by the kathode and X-rays. According to the accepted hypothesis, the positive and negative particles or ions of the gas are knocked apart by the radiations, and the motion of these free charged ions when directed by an electric field constitutes the electric current. If an ionized gas is left to itself the positive and negative particles soon reunite, and, in fact, the reuniting process goes on all the time in proportion to the number of free ions in the gas, so that under any given intensity of ionizing radiation a condition of equilibrium is soon reached in which the reuniting goes on as fast as the ionizing. Since the amount of ionization may be measured by measuring the electrical conductivity of the gas, this affords a convenient means of comparing the relative strengths of radio-active substances, and one which is much more rapid and accurate than the photographic one. It is by no means certain, however, that the radiations most effective for ionization will therefore produce most effect on a photographic plate. Ionization is proportional to the absorption of the radiations by the gas, so that if a bit of radio-active substance be placed between two metal plates a greater current may be sent between them when they are two centimeters apart than when they are only one, the greater thickness of the air in the first case absorbing more of the radiations.

An ionized gas is in many respects similar to an ordinary liquid electrolyte, and Lord Kelvin has shown that when a plate of copper and a plate of zinc are connected by a wire and the air between the plates exposed to radiations from uranium compounds, a current flows through the connecting wire just as if the plates were immersed in a liquid electrolyte. It has recently been shown that the Becquerel rays decrease the resistance of selenium, just as light and the X-rays do.

PENETRATING POWER.

The radiations from the various substances are not at all homogeneous, some being very penetrative, others being easily stopped by any substance. Polonium radiations, while intense, are of the non-penetrating kind, being stopped by even the

thinnest metal foil. Uranium radiations, and therefore Crookes' UrX radiations, are much more penetrating, passing through metals, glass and in fact all substances, but with considerable loss of intensity. Thorium compounds emit radiations of at least two very different penetrating powers, one part only feebly penetrating, another as penetrating as the UrX radiations. Radium and actinium also emit both penetrating and non-penetrating rays, some of the radium rays being the most penetrating of all. Screens of sheet metal act as sieves for the rays, soon cutting off the less penetrating rays and allowing the more penetrating kind to go through with but little diminution in intensity. One sheet of tin, 0.0025 mm. thick, transmitted 44% of the radiations from one radium specimen, two sheets of the same thickness transmitted 31%, and 15 sheets 15%. A sheet of glass 0.16 mm. thick transmitted 26%, and ten plates 16%. Aluminum 0.16 mm. thick transmitted 28%, six sheets 16%. On account of the non-homogeneity of the radiations it has been very difficult to determine the law of absorption, but it appears that for the rays of the most penetrating type, at least, the absorption is proportional only to the density and thickness of the absorbing screen, the kind of material, whether platinum, paper, glass, air or other substance, making but little difference. Because some of the less penetrating rays are absorbed by the salt itself, there is a larger proportion of the very penetrating rays in the radiations from a thick layer of the salt than in those from a thin layer.

DEFLECTION IN A MAGNETIC FIELD.

Several experimenters discovered about the same time that some of the Becquerel rays are affected by a magnetic field. This brought out strongly their resemblance to the kathode rays, and further experimenting proved that if a beam of radium radiations is made to pass through a magnetic field which is perpendicular to the direction of the beam, then the beam is deflected just as a beam of kathode rays would be, that is, just as a stream of negatively charged atomic projectiles would be deflected. This fact furnished the basis for the present accepted hypothesis, namely, that the deviable rays consist of a stream of rapidly moving particles, charged with negative electricity. The deflection in a magnetic field gives further proof of the non-homogeneity of the radiations. The experiment is as follows: A vertical beam is obtained by placing the radio-active salt at the bottom of a narrow hole in a block of lead, which is then placed on a horizontal photographic dry-plate or a fluorescent screen, in the horizontal field of a large electro-magnet. When the magnet is energized the vertical beam of rays is deflected in a direction always perpendicular to its direction of propagation, and also perpendicular to the magnetic lines of force, so that it is finally bent over until it falls upon the plate or screen. The impression produced is not a spot, but a band or magnetic spectrum, which could not be the case if the beam were composed of homogeneous radiations. According to the electrified-projectile hypothesis this can be explained by saying that the particles do not all have the same velocity, in which case those having the highest velocity would be the least deflected. This view has support in the fact that of the deviable rays, the least deviable are the most penetrating, as we should expect from the higher velocity of the particles. Becquerel found that for the rays from a sample of radium the product of the strength of the field into the radius of curvature of the path varied from 350 to 3,000.

There are, however, certain rays that are not deflectable in a magnetic field, and

these are of the least penetrating kind, which, according to the charged-particle hypothesis, should, on the contrary, be most deflected by the field. A satisfactory hypothesis as to the nature of these non-deflectable, non-penetrating radiations has not yet been put forth. Perhaps they consist of particles of much larger mass than those of the deflectable rays. M. Villard finds also in the radium radiations a small proportion of very penetrating, non-deflectable rays, quite similar to the X-rays.

ELECTROSTATIC EFFECTS.

Now a stream of charged particles deflectable by a magnetic field should also be deflected by an electrostatic field. This is found to be the case. Furthermore, a shower of negatively charged particles ought to impart a negative charge to an insulated conductor. Of course in this case air would not act as an insulator, for it becomes a conductor under the action of the rays. M. and Mme. Curie got around this difficulty by insulating a conductor with a thin layer of wax over its surface, then exposed it to radium radiations and found that it became highly charged negatively. Insulating some of the radium salt in the same manner with wax, they found that it became highly charged positively, a beautiful corroboration of the theory that there is a separation of the atomic particles with their charges. If, as now seems almost certain, the negatively charged part of the atom has a mass only a small fraction, a thousandth perhaps, of that of the positive part, it is very reasonable that the negative particles would be the ones to be shot out in case of interatomic commotions. The rate of charging in the experiment was about 4×10^{-12} amperes per sq. cm. of the radium salt.

VELOCITY, MASS AND ENERGY OF THE RADIATIONS.

The velocity of a charged particle and the ratio of the charge to the mass may be found by comparing its path in a magnetic field with its path in an electrostatic field, Then assuming the charged-particle hypothesis it should be possible to calculate the velocity of the particles in the deflectable rays from the radio-active substances. This has been done by M. Becquerel. The curvature of the path in the magnetic field can be measured without much difficulty, but the deflection in the electrostatic field is very small. The difficulty of the experiment is also increased by the complex character of the radiations, making it uncertain if rays of just the same kind are being observed in the two fields. Some confidence, however, must be placed in the results, though they give for the velocity of the particles an astounding figure, about half the velocity of light. How from a quiet, peaceful bit of white salt particles can be shot off with such a velocity as this remains for explanation. The ratio of the charge to the mass of the particles is of the same order as in the case of the kathode rays, another evidence that the atomic charges are invariable and inseparably connected with the particles.

By measuring the rate at which a charge is imparted to a conductor, and then using the values of the velocity and of the ratio of the charge to the mass determined as above, the kinetic energy per second of the particles emitted may be calculated. For a sq. cm. surface of a very active radium preparation it has been found to be 5.1 ergs per second, or five ten-millionths of a watt. The mass of the particles, calculated from the same data, is exceedingly small, the loss from a sq. cm. of surface being something like a milligram in a thousand million years. M. Becquerel observes that it is of the same order as the evaporation of certain odorous bodies.

Professor Rutherford and Mr. McClung made last year some interesting experiments on the energy required to produce ionization

of gases by kathode and X-rays. Assuming that the same energy is required to produce ionization by the Becquerel rays, they estimate that a sq. cm. surface of a thick layer of uranium oxide gives off energy at a rate not less than 10^{-11} calorie per second, which is sufficient to raise the temperature of 1 gram of water 1° C. in 3,000 years. In the case of radium, 100,000 times as active as uranium oxide, the energy given off is not less than 3,000 calories per year for a gram of substance. This value for the energy is 40 or 50 times as large as the value mentioned above, obtained by the other method. That the amount of energy concerned is so small emphasizes the extreme delicacy of the photographic and ionization tests.

SECONDARY RADIATIONS.

X-rays impinging on some substances induce secondary radiations, and it was soon found that the Becquerel rays also possess this power, with the important difference that the secondary radiations induced by the Becquerel rays continue after the action of the primary rays has ceased, which is not the case with those induced by the X-rays. These secondary radiations affect photographic plates and ionize gases. The radium preparations are the most active in producing secondary radiations, and the effect is produced equally well in the case of such different substances as platinum, zinc, bismuth and even paper. Up to a certain limit the intensity of the secondary rays increases with the time of exposure to the radium; after the removal of the radium the intensity gradually weakens, disappearing altogether after some hours. The source of the secondary rays was thought to be a fine dust which escapes from the radium and settles on neighboring bodies, but it cannot be removed by washing, and the radium rays have the power of imparting it even after passing through metal screens. It seems too that this power of emitting radiations may even be imparted to gases. A number of substances may be made strongly radio-active by precipitation from solutions containing small amounts of the most active substances, and several times these temporarily active substances have been mistaken for compounds of new elements. It is not yet known to what extent the secondary radiations are like the primary, for their intensity is so small that a comparison is difficult.

Thorium oxide gives off a remarkable vapor or 'emanation' which causes a strong secondary radio-activity. This emanation can pass through paper and even very thin metal. It gradually diffuses itself throughout the air and is carried about by air currents. Air containing the emanation retains its electrical conductivity for as long as ten minutes after the thorium oxide is removed, though ordinary ionized air loses its conductivity in a few seconds. The emanation is not removed from the air by drawing it through wool or bubbling it through water or sulphuric acid. Any substance charged with negative electricity collects and concentrates the emanation, becoming very radio-active after a few hours in the presence of thorium oxide. Sand-papering or treatment with sulphuric acid removes the emanation from a platinum wire on which it has been concentrated. On afterwards evaporating the acid a radio-active residue may be obtained. The thorium emanation much resembles a fine radio-active dust.

NATURE OF THE RADIATIONS AND SOURCE OF THEIR ENERGY.

We may say then that for one component of these complex radiations a satisfactory explanation is offered. This component is of the same nature as the kathode rays, and consists of a rapidly moving stream of minute material particles each having its charge of negative electricity.

Another component is similar to the X-rays, and is probably a phenomenon of the ether rather than of ordinary matter. Perhaps this component is produced by the action of the first component, as the X-rays are produced by the action of the kathode rays. For the rest no satisfactory explanation has been given. Many of the secondary effects seem to result from a fine dust emitted from the radio-active substance. Possibly there is only a single primary radiation, the rest being secondary effects, as the kathode rays generate the X-rays and these in turn generate their complex secondary radiations.

The chemical nature of the radio-active substances or elements is still little understood, nor is it surprising when one considers the difficulty of working with substances occurring in such minute quantities as these. Only one new element, radium, is definitely established. Hofmann and Strauss thought they had isolated another new radio-active element, but while still claiming the new element, they now admit that it is not radio-active.

The question of the source of energy in these radiations is yet unanswered. Is the energy potential in an unstable molecular or atomic structure, or is it supplied continuously by outside sources? In the first case, how long will the energy last? In either case, is it a property that matter in general may under proper conditions assume, or is it, as it seems, restricted to a very few peculiar elements? Heat or cold, high or low pressure, has little influence on the emission of the rays. Mme. Curie once put forth the hypothesis that perhaps the radiation is induced in the radio-active elements by a sort of transcendental radiation more penetrating than the X-rays and pervading all our space. Professor Geitel found that if so the exciting radiations penetrate easily hundreds of yards of rock, for radium was still active at the bottom of the deepest mine to which he had access. Finally, the study of the radio-active substances will surely lead to a better knowledge of that which is the subject of much of the physical research of to-day, the intimate structure of matter.

GEO. B. PEGRAM.

COLUMBIA UNIVERSITY,
June 21, 1901.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE following have completed their membership in the American Association for the Advancement of Science during the month of June.

Dr. Francis E. Abbot, Author, 43 Larch Road, Cambridge, Mass.

Ernest Kempton Adams, Scientific Investigator, 455 Madison Ave., New York, N. Y.

Harry Alexander, Elec. and Mech. Engineer, 18 and 20 West 34th Street, New York, N. Y.

E. B. Alsop, Metallurgy and Engineering, 541 Wood Street, Pittsburg, Pa.

James I. Ayer, Electrician, 5 Main Street Park, Malden, Mass.

Ralph Baggaley, engineer, Pittsburg, Pa.

Daniel Moreau Barringer, Geologist and Mining Engineer, 460 Bullitt Building, Philadelphia, Pa.

Professor Walter B. Barrows, Prof. of Zoology, Agricultural College, Michigan.

Francis Bartlett, 40 State Street, Boston, Mass.

James Newton Baskett, Author-Zoologist, Mexico, Mo.

Rev. John Mallery Bates, Botany, Callaway, Neb.

Dr. Henry Harris Aubrey Beach, Physician, 28 Commonwealth Avenue, Boston, Mass.

Professor Arthur E. Beardsley, Prof. of Biology, State Normal School, Greeley, Colo.

Bernhard Arthur Behrend, Civil and Elec. Engineer, Station H, Cincinnati, Ohio.

August Belmont, 23 Nassau Street, New York City.

Charles W. Bennett, Geologist, Coldwater, Mich.

Dr. Augustus C. Bernays, Specialist in Embryology, Anatomy and Surgery, 3623 Laclede Avenue, St. Louis, Mo.

Solomon H. Bethea, United States Attorney, Chicago Club, Chicago, Ill.

Dr. Leslie D. Bissell, Physics, Hotchkiss School, Lakeville, Conn.

Dr. John B. Blake, Physician, 302 Beacon Street, Boston, Mass.

Lemuel Stearns Boggs, care Sargent & Lundy, 1,000 Isabella Building, Chicago, Ill.

Henry Martin Boies, President Moosic Powder Co., 530 Clay Avenue, Scranton, Pa.

Dr. Arnold L. Bossi, Chemist and Colorist, Manchester Mills, 1962 Elm St., Manchester, N. H.

Louis F. G. Bouscaren, Chief Engineer, Water Works Commis., City Hall, Cincinnati, Ohio.

Albert A. Brooks, Teacher of Botany and Zoology, High School, Kansas City, Kans.

Frederick Burbidge, Mgr. Bunker Hill and Sullivan Mining and Concentrating Co., Kellogg, Idaho.

M. D. Burke, Civil Engineer, 404 Pike Building, Cincinnati, Ohio.

Robert E. Burke, Chemist, Mechanic Arts High School, 156 M Street, S. Boston, Mass.

Samuel Cabot, Chemist, 70 Kilby Street, Boston, Mass.

Professor Florian Cajori, Prof. of Mathematics, Colorado, Col., 1119 Wood Avenue, Colorado Springs, Col.

Frederic J. Carnell, Physics, 58 North Sheffield Hall, New Haven, Conn.

Arthur E. Childs, Mechanical and Electrical Engineer, 23 Central Street, Boston, Mass.

Isaac M. Cline, M.D., Section Director, U. S. Weather Bur., Weather Bur., Galveston, Texas.

Mendes Cohen, Civil Engineer, 825 N. Charles Street, Baltimore, Md.

Vernon G. Converse, Mechanical Engineer, 15th Street and Liberty Avenue, Pittsburg, Pa.

Robert E. Cranston, Mining Engineer, Folsom, Cal.

David F. Crawford, Supt. Motive Power, Penn. R. R. Co., Fort Wayne, Ind.

Albert C. Crehore, Vice-President Crehore-Squier Intelligence Transmission Co., Brookside Park, Tarrytown, N. Y.

Frank H. Cockard, Civil and Mining Engineer, L. B. 34, Wheeling, W. Va.

Geo. W. Curtiss, Weatherford, Texas.

Irving S. Cutter, Botanist and Zoologist, Box 732 Lincoln, Nebr.

Dr. W. H. Dalrymple, Prof. Veterinary Science, La. State University, Baton Rouge, La.

Charles F. Davis, Chemist, Fort Collins, Colo.

William H. Davis, Assistant in Psychology, Columbia University, New York, N. Y.

William W. Davis, Chemist, Virginia Iron, Coal and Coke Co., Bristol, Tenn.

William H. Dean, Chemist, 167 West River Street, Wilkesbarre, Pa.

Frederic A. Delano, Supt. Motive Power, C. B. and Q. R. R. Co., 209 Adams Street, Chicago, Ill.

Alva C. Dinkey, General Supt. Steel Works, Homestead Steel Works, Munhall, Pa.

Rev. Charles F. Dole, Jamaica Plain, Mass.

Alexander Dow, Mech. and Elec. Engineer, 844 Cass Avenue., Detroit, Mich.

Dr. H. R. Dudgeon, Physician and Surgeon, Sealy Hospital, Galveston, Texas.

S. W. Dudley, Mech. Engineer, 15 Austin Street, Westville, Conn.

Robert B. Dunlevy, Geologist and Chemist, Winfield, Kans.

Dr. Robert T. Edes, Physician, 15 Greenough Avenue, Jamaica Plain, Mass.

August Eimer, 220 East 19th Street, New York City.

Robert W. Ellis, Tabor, Iowa.

Morton J. Elrod, Prof. of Biology, Univ. of Montana, Missoula, Mont.

Arthur B. Emmons, Newport, R. I.

Frederic J. Falding, Consulting Chemical Engineer, 52 Broadway, New York City.

Professor Richard E. Fast, Prof. Amer. Hist. and Political Sci., State University, Morgantown, W. Va.

William B. Fisher, Mining Engineer, Carterville, Mo.

M. Judson Francisco, 49 Merchants' Row, Rutland, Vt.

George C. Gardner, Mills Bldg., 35 Wall Street, New York City.

Albert O. Garrett, Teacher of Science in High School, Fort Scott, Kans.

Frank A. Giffin, Mathematician and Physicist, Boulder, Colo.

Dr. Joseph L. Goodale, Physician, 397 Beacon Street, Boston, Mass.

Elmer F. Goodwin, Prof. of Physics and Chemistry, Athens, W. Va.

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Julian H. Granbery, Ass't Engineer, Manhattan R. R. Co., 670 Pennsylvania Avenue, Elizabeth, N. J.

Arthur O. Granger, Astronomy, Physics, Cartersville, Ga.

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Charles M. Hall, care Pittsburg Reduction Co., Niagara Falls, N. Y.

Dr. Frank K. Hallock, Physician and Surgeon, Cromwell, Conn.

Mrs. Carolyn W. Harris, Chilson Lake, N. Y.

Frederick S. Harris, Mining, Monticello, Kans.

J. Dawson Hawkins, Chemist, Colorado Springs, Colo.

Charles I. Hays, Northside High School, Denver, Colo.

Tracy E. Hazen, Director of Museum and Botanist, The Fairbanks Museum, St. Johnsbury, Vt.

Harry E. Heath, Chief Engineer Eddy Elec. Mfg. Co., Windsor, Conn.

Junius Henderson, 1933 13th Street, Boulder, Colo.

Conrad E. Hesse, Meteorology, U. S. Weather Bureau, 807 Mass. Avenue N. E., Washington, D. C.

John A. Higginson, 260 Clarendon Street, Boston, Mass.

John L. Hildreth, 14 Garden Street, Cambridge, Mass.

Franklin W. Hooper, Curator of Brooklyn Institute, Brooklyn, N. Y.

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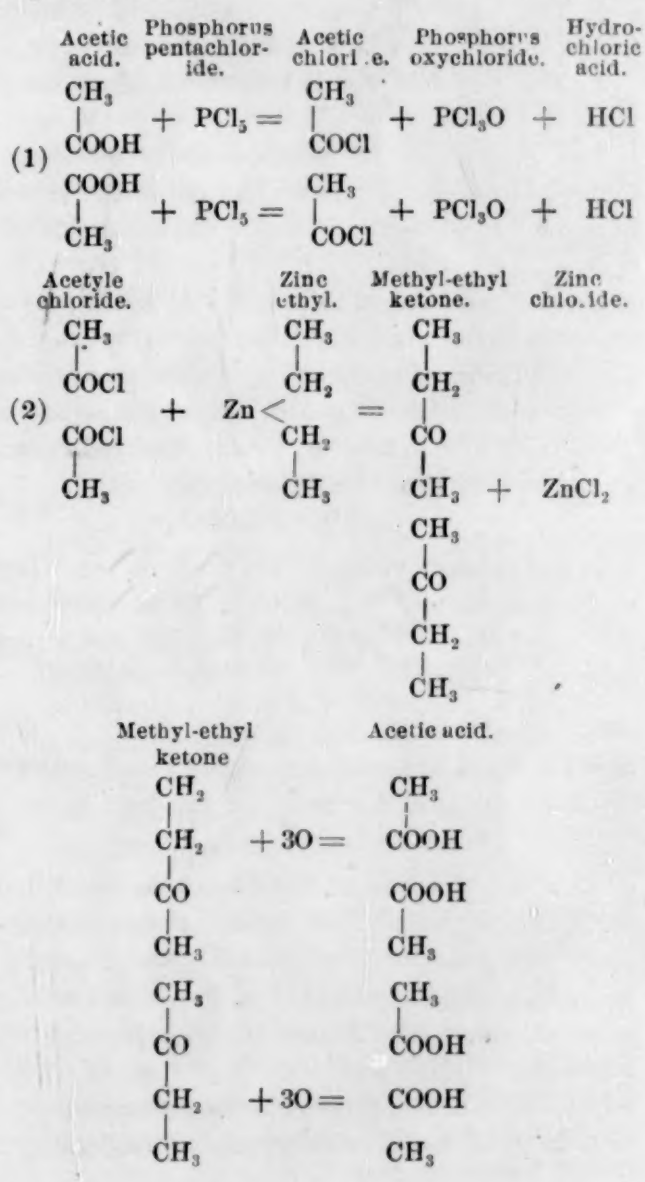
SCIENTIFIC BOOKS.

Les problèmes de la vie. 1re Partie. La Substance vivante et la cytodiérèse. Par DR. ERMANNO GIGLIO-TOS. Turin. 1900.

A title, such as the author of the present volume has selected, is apt to excite suspicion by suggesting a discussion of phenomena for the explanation of which the data at our disposal seem at present hardly sufficient. The time when the biologist was content with an *ignoramus* or with the endeavor to conceal his ignorance under cover of vital force has passed away, and a school has arisen which pins its faith on the investigation of Entwicklungsmechanik, but which, it must be confessed, still subsists on the substance of things hoped for. The pendulum has swung from the predication of a special force to the application of the fundamental principles of physics and mechanics, but without as yet yielding the desired explanation of protoplasmic activity, possibly because the new position has not yet been sufficiently exploited.

Professor Giglio-Tos, however, believes that the lack of conclusive results is due to the pendulum having swung too far; the basis of an explanation of the phenomena of life is to be sought, in his opinion, not so much in the physical as in the chemical principles involved. The most fundamental of all the vital functions is assimilation and this he believes is exclusively a chemical phenomenon, perfectly analogous to the changes which organic chemical compounds may be made to undergo in our laboratories, acetic acid, for instance, if supplied with the proper food in the way of reagents, assimilating these and producing with their aid additional molecules of acetic acid. The example which he gives in illustration of the chemical nature of assimilation is so suggestive that it may be repeated here.



Thus *two* molecules of acetic acid supplied with the proper food (phosphorus pentachloride zinc ethyl and oxygen) have been able to assimilate additional atoms of CH.O, the result being the formation of *four* molecules of acetic acid (growth), together with certain excreta (phosphorus pentachloride, hydrochloric acid and zinc chloride). Arguing for this case, Professor Giglio-Tos lays down the following conditions as necessary in order that a molecule may exhibit the phenomena of assimilation :

1. It must be able, with the aid of assimilation, to divide into molecules similar to itself.
2. The necessary nutritive substance must be always present.
3. The nutritive and secondary (excreta) products must not act destructively upon each other.
4. The various processes of assimilation must follow one another in a definite order.
5. The physical conditions (heat, light, etc.) must be suitable.

The molecules of protoplasm, which are termed *biomolecules*, possess or exist under these necessary conditions and hence exhibit assimilation.

Having established this point, the author then proceeds to discuss differentiation. If we represent the primary molecule by a and the various compounds formed during the assimilative process by b, c, d, and M, the process indicated above may be graphically composed as

$$a \cdots b \cdots c \cdots d \cdots M = a + a$$

It is not necessary, however, that the resulting molecules should be identical in composition with that from which they arose, and the series may run thus :

$$a' \cdots b' \cdots c' \cdots d' \cdots M' = c' + c'$$

and finally it is possible that the two resulting molecules may differ from one another, thus

$$a'' \cdots b'' \cdots c'' \cdots d'' \cdots M'' = c'' + i.''$$

As a combination of these various results of assimilation, which the author terms respectively autogenetic, homogenetic and heterogenetic, the differentiation of the biomolecules is produced. The biomolecules represent for Professor Giglio-Tos the fundamental constituents of protoplasm, but they are chemical constituents, and like many of his predecessors he finds it necessary to postulate the existence of living particles composed of an aggregation of biomolecules and which he terms *biomores*. These he likens to a double salt and, since each biomore is composed of living molecules, it too is a living compound, and from the biological standpoint may be regarded as a symbiosis of molecules, since for the preservation of the biomore the component biomolecules must react favorably upon one another. The biomores are aggregated symbiotically to form a *bioplasma* and a symbiotic system of biomores which performs all the functions of life and constitutes a living unit, is termed a *biomonad*, while, finally, a *cell* is a biomonad 'characterized by the chemical nature of certain biomores which form its nucleus' or in other words is a differentiated biomonad.

Such in brief is the fundamental idea which the author expounds in the first five chapters of his book, and in the succeeding pages he proceeds to discuss the phenomena of cell division in the light of this idea. Reproduction is after all merely discontinuous growth and the causes which determine the growth or division of a molecule will be the same in the case of a biomore, or biomonad, or a cell. The division of a molecule depends upon the orientation of its constituent molecules, and the division of a biomonad, accordingly, is due to the orientation of its constituent biomores. It would lead us too far to attempt to follow the author in his minute analysis of the phenomena of karyokinesis, and it must suffice to quote from the concluding paragraphs of the book : "The property of division, which characterizes living substances, is not due to a special force. It is only the necessary, inevitable consequence of the constitution of this substance and of assimilation." "The force which unites the particles of living matter is the same as that which unites the particles of dead matter and is sufficient for the explanation of the phenomena of division. Division always occurs under the action of this force, whatever may be the constitution of the living substance, and the various figures which appear during division and which characterize cytodieresis are only the morphological consequences of that constitution."

In conclusion, it must be stated that notwithstanding the complexity of the problems discussed and the minute analysis to which they are subjected, the book is written with a rare degree of conciseness and lucidity. Professor Giglio Tos has certainly presented a somewhat abtruse subject in a most interesting manner and has given a new point of view, a working hypothesis which cannot fail to influence future cytological work. The book is suggestive from cover to cover, and the second volume, which is to treat of 'Ontogenesis and its Problems,' will be awaited with interest.

J. P. McM.

A. de Bary's Vorlesungen über Bakterien. Dritte Auflage. Durchgesehen und teilweise neu bearbeitet. Von W. MIGULA. Leipzig, Wilhelm Engelmann. 1901. Mk. 3.60.

The name of DeBary's 'Lectures on Bacteria' still has power to conjure up pleasant memories in those persons who remember when this classic brochure was the only worthy book devoted exclusively to the young science of bacteriology. The ponderous tomes, too often filled with unassimilated facts, that have since appeared in abundance sometimes force us to recall with regret the days when selection of material and skilled exposition were not incompatible with completeness.

The attempt to put new wine into old bottles has always encountered certain experimental difficulties, and it cannot be said that these difficulties have been altogether overcome by Dr. Migula, although something of the charm of the original lectures has been retained. The general arrangement of the sections is the same as in the original edition, while the insertion of new facts and the dropping of outworn creeds is perhaps as skilfully carried out as could be expected. In spite of the defects to be anticipated in a rewritten work of this sort, the lectures will readily command interested readers. It will always be questioned, however, whether the successive changes in the viewpoint of a rapidly growing science do not continuously demand new methods of exposition, and whether it is quite fair to a book that has served well its day and generation to bring it again upon the stage.

E. O. J.

A Laboratory Guide in Elementary Bacteriology. By WILLIAM DODGE FROST, Instructor in Bacteriology, University of Wisconsin. Published by the Author, Madison, Wisconsin, 1901.

The development of bacteriology as a subject of general scientific importance has led in several American universities to the introduction of courses in bacteriology into the regular undergraduate curriculum, and has created a demand for a kind of laboratory training adapted to the requirements both of the college student and of the student of medicine. The book before us outlines a course of this character, elaborated during several years of experience at the University of Wisconsin. The arrangement and choice of matter will be generally commended. The ordinary technical procedures are lucidly described with the aid of many diagrams, and are in thorough accord with the latest and best practice. The book is not distorted by being wrested to special utilitarian ends, but is rather designed to lay a broad foundation for subsequent specialization in any branch of bacteriology. It is admirably fitted for this purpose.

E. O. J.

Elements of Quaternions. By the late SIR W. R. HAMILTON. Second edition. Edited by PROFESSOR C. J. JOLY. London, Longmans & Co. Vol. I., pp. xxxiii + 583; Vol. II., pp. liv + 502; quarto.

The first edition of the 'Elements of Quaternions' consisted of 500 copies; and as many of these were presented to men of science, the book soon became scarce on the market. The published price was one pound; five times that amount has been paid for a single copy. In fact it frequently happened that a student could not obtain a copy of the English edition, and was obliged to content himself with Glan's German translation. Therefore we hail with pleasure a second edition of this classic of the mathematics, especially as it is printed in two handsome quarto volumes, and can be purchased at a moderate price.

Hamilton spent the last seven years of his life in the preparation of the 'Elements,' which he designed to be the *Principia* of space-analysis. He did not live to see them published.

The successive sheets were revised by him and printed off under his direction; but at his death some intended articles remained unwritten, although everything up to them had been revised and printed off. Professor Joly testifies in his preface that he has found extraordinary accuracy both of matter and of printing in the first edition. To the new edition he has added a preface, an index, an analysis of each article in the table of contents, footnotes and an appendix containing more lengthy notes on the following subjects: 'Quaternion Determinants,' 'Miscellaneous Properties of Two Linear Vector Functions,' 'The Strain Function,' 'On the Specification of Linear Vector Functions,' 'On the General Linear Transformation in Space,' 'On the Theory of Screws,' 'On Finite Displacements,' 'On the Kinematical Treatment of Curves,' 'On the Kinematical Treatment of Surfaces,' 'On Systems of Rays,' 'On Hamilton's Operator ∇.'

It was Abel who said that if one wished to make progress in mathematical science he ought to study the original work of the master rather than the presentations of his pupils. This maxim applies especially to quaternions; and for facilitating the study of Hamilton's great work the Printing Board of Trinity College, Dublin, and the editor, Professor Joly, deserve the thanks of the mathematical world.

Alexander Macfarlane.

SOCIETIES AND ACADEMIES.

THE RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN.

The Research Club of the University of Michigan was organized two years ago, its membership being made up from the University Faculties, and its aim being the promotion of research. During the year just closed, the Club has met six times, and its proceedings may be briefly summarized as follows:

At the first meeting, held in October, 1900, the theme for discussion was 'The Promotion of Research at the University of Michigan.' Dr. Vaughan, President of the Club, addressed the members on the organization and objects of the Club, and closed with remarks on the topic of the evening. Professors Wenley, Ziwet, Adams and Reighard spoke by appointment, and they were followed *ex tempore* by Dr. Hulett, Dr. Bigelow and Dr. Dock.

At the second meeting, November, 1900, the speakers were Professors Hempl and Newcombe. Professor Hempl spoke on the formation of dialect districts in the United States, showing with the help of charts the boundaries of various dialectic differences. The speaker gave concrete examples of variation in the use and pronunciation of words and phrases, and made some attempt to trace the historical development of these variations.

Professor Newcombe narrated his experiments on the sensitive curves made by roots in response to the streaming of water, and in response to contact with a foreign body. It was shown that about one-half of the thirty-three species of plants tested are sensitive to the water-current, and that of the four water-plants used, none is sensitive. So far as tested, all those plants responding to the water-current responded to the contact of a foreign body, and those not responding to one did not respond to the other. Hence it is supposed, though not demonstrated, that the response in both cases is response to one-sided pressure. A summary of these results may be found in Science, XIII. (1901), p. 250.

The third meeting came in January, 1901. Professor Gomberg detailed the experiments which led to his discovery of the trivalency of carbon. Accounts of this work may be found in *Jour. Amer. Chem. Soc.*, **22**, 757; *Ber. d. d. Chem. Gesellsch.*, **33**, 3150; *Amer. Chem. Jour.*, **25**, 317. Dr. H. S. Jennings stated his results in studying the reactions of infusoria to external stimuli, illustrating his summary with experiments, made visible to all present by projection with a lantern. The researches of which Dr. Jennings gave an account have been published in full in various journals, and an abstract appeared in Science for January 11, 1901 (XIII., 74), in the report of the Zoological Journal Club of the University of Michigan.

The February meeting listened to papers by Dr. George Dock and Professor W. B. Pillsbury. Dr. Dock described the method of teaching internal medicine in the University. The limited time in the medical course makes it

difficult for undergraduates to do more in the way of research than to work out some original detail. In this work, they make extensive use of the laboratory method, and the effort is made to require students to think for themselves. The paper closed with the citation of subjects of investigation followed in the medical clinic. Professor Pillsbury presented a summary of a paper entitled 'Do the Sensations of Movement Originate in the Joints?' The narration of his experiments showed that a current through the ankle or elbow was as effective in reducing the sensitiveness of knee or elbow as currents through the joints in question. This fact, he stated, can only be explained if the sensory endings in the tendon or muscle are the seat of the sensation, and not the joints as is usually claimed.

In the March meeting Dr. Warthin and Dr. Hulett presented papers. Dr. Warthin spoke on 'A Contribution to the Normal Histology and Pathology of the Hemolymph Glands' (preliminary report). In this paper the occurrence of glands containing blood-sinuses instead of lymph-sinuses is for the first time shown to be constant in the human body. The distribution of these glands, their minute structure, their hemolytic function under normal conditions, etc., are described. Two types of these glands—splenolymph and marrowlymph glands—are found to occur. In a number of cases of fatal anemia, pathological changes were found in these glands, showing conclusively that they may become centers of red blood-cell formation.

Dr. Hulett presented a report of his measurements of 'The Relation Between Surface Energy and Solubility.' The theoretical relation between surface tension and solubility was discussed, and experimental data given to show that the solubility of a substance depends upon the curvature of the surface—*i. e.*, the finer the state of division the more soluble (t constant). The solubility of gypsum was increased 19 % by decreasing the size of the particles from 2 μ to 0.3 μ; barium sulphate showed an increase of 100 % in solubility, and mercury oxide 300 % over that of the normally saturated solutions.

At the last meeting, held the 29th of May, Professor Lloyd read a paper bearing the title 'Some Unscientific Reflections upon Science.' The paper was vigorously discussed, some of those present thinking that the attitude of scientific men had been unfairly portrayed, while others supported Professor Lloyd. This paper is soon to appear in full in SCIENCE. At this meeting also, Professor E. D. Campbell detailed in a highly interesting manner his researches on the microscopical and chemical composition of steel. His paper gave a comparison of the heat of formation, and the action of nitric acid and of iodine on cementite, one of the constituents of high carbon steel, and on the pure carbide of iron isolated from pearlite. From these comparisons the author concludes that free cementite is not only not identical with the carbide of pearlite, as is usually assumed, but is probably not a carbide at all, but a solid solution of carbon in iron.

FREDERICK C. NEWCOMBE,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

DURING the half year ending with June, this organization held four meetings in the Chemical Lecture Room of the University of Texas. On January 18, Dr. William Morton Wheeler, professor of zoology in the University, lectured upon 'The Relation of Ants to other Living Organisms'; on March 23, Dr. William L. Bray, professor of botany, lectured on 'Texas Forests: their Present Condition and their Future Management'; and on April 5, Dr. William B. Phillips, the lately appointed director of University Mineral Survey, lectured on 'Texas Petroleum.' The lectures of Messrs. Wheeler and Bray were illustrated by a liberal use of lantern slides.

The program of the annual meeting, held on June 10, was as follows: 'Contributions of the Nineteenth Century to Education,' William S. Sutton, M.A., professor of the science and art of education in the University of Texas.

'Rice Irrigation in Texas,' Thos. U. Taylor, M.C.E., professor of applied mathematics in the University of Texas.

'Texas Railway Stock and Bond Law,' R. A. Thompson, C.E., expert engineer to the Texas Railroad Commission.

'Texas Minerals and Mineral Localities' (by

title), Frederic W. Simonds, Ph.D., professor of geology in the University of Texas.

'Notes on the Yellow Oxide of Mercury,' E. P. Schoch, M.A., and O. W. Wilcox, school of chemistry, University of Texas.

Professor Sutton's paper was a thoughtful exposition of the subject—'Contributions of the Nineteenth Century to Education'—though necessarily brief. The closing paragraph, in the form of a summary, was as follows: "In conclusion, let us consider for a moment the question, What is the significance of all these contributions which the last one hundred years have made to education? Upon what principle can be explained the accomplishment of a task so stupendous as to involve, first, the most radical changes with respect to the aim in education; second, the vast expansion of the culture-material to accomplish this aim; third, the discovery of scientific method in instruction; fourth, the provision for the professional training of teachers; fifth, the organization and partial development of gigantic systems of public instruction at public expense; sixth, the increase of number of the learned professions by recognizing the dignity of applied sciences; and lastly, the extension of the privileges of education to the child in the kindergarten, and to the parent in the home? There can be but one answer to this question—it is the spirit of real humanism, which is the distinctive characteristic of the nineteenth century, a spirit which through the reign of reason seeks to bring all men to a knowledge of the truth, and which has for its ultimate purpose the complete physical and spiritual enfranchisement of the human race."

Mr. Thompson in discussing 'The Texas Railway Stock and Bond Law,' called attention to the fact that Texas is the only State in which the issuance of railway stocks and bonds is controlled by the government, and also that it is the only one which has prescribed an absolute basis for the valuation of railway properties.

The Stock and Bond Law declares that the issuance and execution of all railway securities are 'special privileges' subject to the absolute control of the State; and that no indebtedness shall be authorized beyond the 'reasonable value of property' to be fixed by the Railroad Commission in accordance with actual cost. Railways existing at the time of passage of the law were valued at the estimated cost of reproduction.

The causes that led up to the enactment of the law were discussed, and it was shown that the contention by investors in railway stocks and bonds, that they should be entitled to charge freight and passenger rates sufficient to earn a fair rate of interest on their holdings, and the support of the Courts in the matter, led the State to limit the issuance of such securities, and to absolutely prohibit the current practice of 'watering' stocks and bonds.

It was shown from the reports of the Railroad Commission that the average amount of stocks and bonds outstanding against the railways of Texas, under the effect of this and other laws, had been reduced from $43,961 per mile in 1894 to $36,926 per mile in 1900. As the Stock and Bond Law continues in effect this will be further reduced, thus permitting a larger per cent. of the net earnings to be used in the upbuilding of the roads and guaranteeing safer investments to the purchasers of railway securities. Notwithstanding the restrictions of the law, railway building in Texas is progressing at a rapid rate—building for purely speculative purposes is checked and legitimate construction promoted. In 1901 it is thought that Texas will easily lead the States of the Union in miles of new railway.

The following notes on the red oxide of mercury were presented by Messrs. Schoch and Wilcox:

"The yellow oxide of mercury has been carefully examined in the laboratory of the school of chemistry of the University of Texas, with a view to clearing up disputed points. By heating up to 200°C. and weighing the water evolved only 0.6% was obtained, which invalidates the statements of Walker and Schaffner that the substance is mercuric hydroxide—a statement made on the basis of results obtained by heating the substance in the open air and reporting the loss as water, and corroborates the work of Siewert. The substance is distinctly crystalline; its specific gravity is 10.6 as determined by Mr. J. M. Kühne, while that of the red oxide is 11."

Upon the report of Messrs. A. M. Ferguson

and John K. Prather, tellers, President Harper announced that the following persons had been duly elected officers of the Academy for the year 1901–1902: President, Professor James C. Nagle of the Agricultural and Mechanical College of Texas, College Station; Vice-President, Dr. Henry Winston Harper, of the University of Texas; Treasurer, Mr. R. A. Thompson, Engineer to the State Railroad Commission; Secretary, Dr. Frederic W. Simonds, of the University of Texas; Librarian, Dr. William L. Bray, of the University of Texas; Other Members of the Council, Hon. Arthur Lefevre, State Superintendent of Public Instruction, and Professors Taylor and Wheeler, of the University.

FREDERIC W. SIMONDS,
Secretary.

THE TORREY BOTANICAL CLUB.

AT the meeting of the Club on May 24, 1901, the scientific program consisted of a paper by Dr. H. M. Richards on 'The Botanical Establishments at Buitenzorg and Tjibodas in Java,' illustrated by numerous photographs, including views of the entrance to the botanic garden and of species growing within, of large lianas a foot in diameter, of the nutmeg, jackfruit, etc., of a tapioca plantation, beautiful treefern groves with alsophilas 40 feet high, etc. Dr. Richards described his journey by train from Batavia 40 miles to Buitenzorg among the foothills of the western mountains. The Botanical Garden of Buitenzorg is at an elevation of over 900 feet, and therefore much cooler than the coast lowlands, the thermometer rarely going below 80° or above 90° F.; rain falls almost every day and almost uniformly through the year; the forenoon is bright and clear; the conditions for plant growth are very much as in a hothouse. A smoldering volcano rises on one side and an extinct one on the other, with a very variable river between.

The history of the Garden dates from Sir Stamford Raffles, British governor, who made a picturesque park about 1811 about his palace, of which the Garden shows some remnants. The Rafflesia, which perpetuates his name, is but occasionally to be seen, and although the Garden endeavors to maintain examples of growth, none were to be had at the time of Dr. Richards' visit. Since the present directorship, about 1880, the Garden has been greatly stimulated. Dr. Lotze, formerly at the Johns Hopkins University, is now one of the staff there. The eight laboratory tables for foreign workers were well filled. Much valuable work has been done of immediate agricultural utility; it is here that the *Cinchona* was acclimated from South America to replace the coffee industry, the coffee plants having been destroyed by a fungus. Experiments toward finding a new rubber supply are in progress, and others to improve vanilla and cocaine production. The Malay workmen who fertilize the vanilla plant by hand prove very skilful. About 30 Europeans and 200 natives form the garden force. In the Botanical Garden proper the orders are not grown in exact sequence, but are grouped and marked off by letters; two specimens of each species are grown; one at least of these is labeled; if grown away from its congeners that fact is indicated by use of a red label. Many screwpines which belong to the salt or brackish water of the coast grow well here in the garden soil. The palm collection is one of the largest in the world; notable features are its specimens of *Areca* and of *Livistona*. Down by a brook is a fine *Casuarina* collection, the Javanese species of which forms large forests on the upper hills resembling northern larch forests. The *Ficus* group is abundant and supplies the favorite shade tree for Javanese streets. Orchids hang especially from trees of the leguminous type, as *Amherstia*, *Cæsalpinia*, etc. These trees are very like candelabra in direction and so expose a reduced surface to the excess of light.

The mountain-garden at Tjibodas, at an elevation of about 4,500 feet, affords the necessary complement to the botanical garden proper. Dr. Richards found it cool enough after the afternoon rain to make a fire very welcome. Good potatoes are raised there, and on the journey up one passes paddy-fields and tea-plantations, including that from which came the Javanese villagers at the Chicago fair. A great jungle of 700 acres extends up to the mountain-top, through which the ascent was taken at 3 A. M. by torchlight, to get the sunrise view. Here tropical oaks develop

into dense balls, epiphyte ferns are in abundance, fallen trunks are covered with moss, and the path through the jungle chokes up so quickly that it has to be cut open often. The jungle is said to contain 1,500 species of trees. The Malays are very keen in perceiving distinctions, and recognize two species of oaks there which the botanists have not yet discriminated. On the heights the aspect becomes more European, *Viola*, *Ranunculus*, *Primula*, *Lonicera*, *Lobelia*, *Oxalis*, etc., appear, and Wallace explained this by supposing these northern forms were pushed south by a glacial climate and on the retreat of the ice they themselves retreated to the mountains.

EDWARD S. BURGESS,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis, on the evening of June 3, 22 persons present, the following subjects were presented:

A paper by Dr. Gellert Alleman, on 'The Action of Alcohol on Certain Isomeric Diazo Compounds,' and one by Dr. G. Hambach, entitled 'A Revision of the Blastoideæ,' were presented by title.

Mr. Wm. H. Roever, of Washington University, read a paper on 'The Effect of the Earth's Rotation upon Falling Bodies,' in which he showed that a body falling from a great height has a southward deviation in the northern hemisphere and a northward deviation in the southern hemisphere. The deviation is given by the formula—

$$\Delta = h\left[\frac{\left(1+\frac{h}{R}\right)^3 K \sin\phi\cos\phi}{1-\left(1+\frac{h}{R}\right)^3 K\cos^2\phi} - \frac{1}{\left(1+\frac{h}{R}\right)}\cdot\frac{K\sin\phi\cos\phi}{1-K\cos^2\phi}\right],$$

in which h is the height through which the body falls, R the radius of the earth (assumed spherical), ϕ the latitude of the place of observation, K the numerical fraction $\frac{1}{215}$ and Δ the deviation. If h and R are given in feet, Δ is in feet.

For $h = 578$ feet and $\phi = 45°$, $\Delta = .00133$ inch.

Mr. G. Pauls presented a number of specimens collected at Eureka, Mo. He exhibited a large number of galls on hickory, maple and oak leaves, commenting on the remarkable variety of the forms of galls made by the minute insects. He had bred a good many of these insects, and found that in successive years a good many different forms came from these galls.

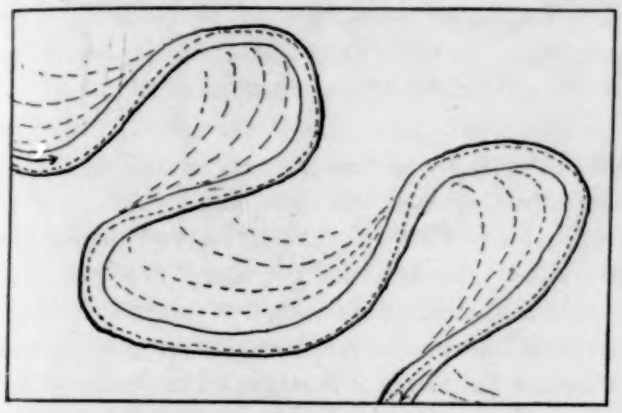
WILLIAM TRELEASE,
Recording Secretary.

CURRENT NOTES ON PHYSIOGRAPHY.

NEW MAP OF THE MISSISSIPPI.

THE 'Preliminary Map of the Mississippi River from the mouth of the Ohio River to the head of the Passes,' published by the Mississippi River Commission (1881–1885, 32 sheets, one inch to a mile), is now to be supplemented by a new edition, of which 13 sheets are issued, bearing in red overprint the changes wrought by the river in about fifteen years. These new sheets are without question the most instructive exhibition of river work, quantitatively determined, yet published in this country; for a river of the first magnitude they have no rival in the world. They deserve to be widely known not only among engineers for whom they were primarily constructed, but among geographers and teachers to whom they convey much information. The general behavior of the meandering river may be inferred from the maps of the earlier edition, from which it appears that the meander system slowly moves down the valley, because the thread of fastest current, thrown toward the outer side of every curve, is therefore delivered to the down-valley side of every tangent or 'crossing' (so called because river boats must there cross the river obliquely in following the channel of greatest depth); and that the meander belt included between tangents drawn outside of the curves slowly widens as the curves increase in radius and arc until it here and there suddenly collapses when a curve is cut off. It may be noted in passing that it is for this reason that the abandoned curves—the ox-bow lakes—are frequently of larger radius than the average of the existing curves. The

down-valley shifting and the broadening of the meander belt are well shown by the pattern of the toe-taps of alluvium that are added, right and left, to the flood plain lobes as the meanders grow and shift, as in the accompanying figure.



All these systematic changes are directly shown by a comparison of the river banks in black and red on the new edition of the map; the wasting banks being systematically located on the outer and down-valley side of the channel, as indicated by heavy lines in the above diagram. Sheet 14 includes the remarkable serpentine meanders near Greenville, where the increase of radius and arc and the down-valley shifting are beautifully shown. Sheets 17, 18 and 19 include a number of curves in the neighborhood of Vicksburg, where the river has destroyed the old levees, thus necessitating the construction of new ones further back from the bank. The bends below Baton Rouge (sheet 25) exhibit relatively small change of position.

THE RIVER SPEY.

THE physiography of the Spey, a river flowing eastward from the Highlands of central Scotland to the North sea, is considered by Hinxman ('The River Spey,' *Scot. Geogr. Mag.*, XVII., 1901, 185–193). A number of the items presented are of interest, but the plan of the article does not imply a comprehensive view of the natural history of rivers. "The Spey valley for the greater part of its extent may * * * be regarded as the result of the slow erosion of the river, continued since early Paleozoic times"; this suggests altogether too great an antiquity; the incision of the Spey valley, and of all the existing valleys, glens and straths of Scotland, beneath the general level of the Highland summits, is probably not older than Tertiary, and certainly not older than middle Mesozoic time. The valleys of "the river and its principal tributaries * * * belong to a very early period in the history of the earth. That they existed before the Old Red sandstone age" is known, because patches of that formation still remain in them here and there; a safer statement would be that an uneven land surface, presumably a region of hills and valleys, was buried by the Old Red, and that some of these ancient valleys have been re-excavated; but it is very improbable that the main and branch valleys of the Spey system are in any close degree coincident with any single ancient valley system. Indeed, much may be said in favor of the initiation of these and certain other Highland valleys on a land surface that was deformed by the tilting and faulting which disturbed the Old Red itself. No special consideration is given to the stage of development of the Spey in pre-glacial time, or to the amount of change produced by glacial action, destructive or constructive; but certain features of the existing river are presented. One is the diversion of a small upper part of river Feshie from the Dee system to the Spey; the diversion is ascribed to normal retrogressive erosion, but it is not shown that the capturing stream had any special advantage over the captured, and no account is taken of glacial action.* Reference is made to the temporary enlargement of the Spey by waters from Glen Spean, on the west, when the lower course of the Spean was obstructed by ice in the Glen Roy district; but that the Pattack and several other barbed headwaters of the present Spean were preglacial members of the Spey system is not considered. Special emphasis is given to the abnormal slope of the Spey; the upper course falls 327 feet in 14 miles, the middle course falls 215 feet in 40 miles; and the lower

* According to the Ordnance map, a gorge on the Feshie two miles southeast of Ruigh-fionntaigh would seem to mark the site of the divide between Spey and Dee before the diversion; and the diversion appears to have been associated with some glacial control. The gorge is not situated where it should be if the upper Feshie had been diverted by retrogressive erosion.

course falls 600 feet in 43 miles. The Feshie makes a fan across the flat middle section of the Spey valley. It is assumed that the Spey once had a normal slope, and it is suggested that a relatively recent uplift in its lower third flattened the middle course and steepened the lower course. Explanation is thus found for the action of the stream in aggrading its middle portion with drift and in cutting down its lower portion in bed rock; but no confirmation for the suggestion of recent uplift is looked for in the neighboring valleys; the success of the suggestion in explaining what it was invented to explain is taken as its verification, without looking for unexpected consequences.

THE RIES.

THE divide between the headwaters of the Main and Neckar on the northwest and the Danube on the southeast is in general determined by the crest of a rather pronounced cuesta of Jurassic limestone, part of which is known as the Swabian Alp. The escarpment of the cuesta, facing northwest, is usually well defined; the back slope, towards the Danube, is on the whole remarkably simple and systematic; but near the middle of its curved length there is a curious, roughly hexagonal depression, called the Ries, about 18 k. in diameter, rather flat floored and well enclosed by the hilly borders of the uplands, with Nordlingen as its chief town. This highly abnormal feature has been likened to a gigantic *maare*, or pit-crater; but although volcanic rocks are confusedly mixed with many others—decomposed granite, schists, mesozoic, tertiary and quaternary—in the floor of the depression, a detailed study by Gruber ('Das Ries, eine geographisch-volkswirthschaftliche Studie,' *Forsch deut. Landes u. Volkskunde*, XII., 1899, 193–291, map, 12 figs.), ascribe the basins to dislocations, similar to those by which various other depressions have been produced in central Germany. It is not clearly explained, however, in just what shares dislocation and denudation are responsible for the basin; no definite statement is made as to the form that the surface had when dislocation took place, as to the form that dislocation produced, or as to the work of denudation on the dislocated form. It is, therefore, difficult to form a clear mental picture of the theoretical forms by which the observed forms are to be explained. In the second part of the essay, the people, settlements, occupations and products of the Ries are described.

W. M. DAVIS.

BOTANICAL NOTES.

'SAVE YOUR PUFF-BALLS.'

UNDER this title Mr. C. G. Lloyd, the well-known student of the higher fungi, has issued a circular asking botanists and others to save puff-balls of all kinds (excepting the large ones) for him. He intends to publish 'in the near future a detailed description of all the Gasteromycetes' and solicits specimens from every one who can help him. Due credit is promised for all specimens sent to him for this purpose. The monograph is to be profusely illustrated with photo reproductions of typical specimens of the species and also with micro-photographic enlargements of the spores and capillitium by Dr. Edward Thompson, an expert in this line of work.

In his directions to collectors Mr. Lloyd says: "For the purpose of study puff-balls must be ripe, that is, they must be full of dry dust. When young most kinds are white and when you cut them they appear like 'cottage cheese.' They are mostly good to eat in this condition, but not to study. The best time to gather them is just when they are getting ripe, just when the white has become moist and discolored and the spines are just drying up and beginning to flake off." * * * "Simply pick them up, handle them carefully so as not to mash them, and if they are just ripening and are moist, spread them out on the floor in a garret or where they will be out of the way and let them dry. Then pack them loosely in a little wooden box; don't squeeze or bruise them." "If your boxes are not full, pack in loosely a little cotton or tissue paper (cotton is better) to fill out. Do not wrap in paper or put in paper bags." Send the boxes, securely wrapped, by mail or express, to Mr. Lloyd at Court and Plum streets, Cincinnati, Ohio.

A NEW WORK ON TREES AND SHRUBS.

THE announcement is made by Messrs. Houghton, Mifflin & Co., of Boston, Mass., that

Professor Charles S. Sargent, author of 'The Silva of North America,' has under preparation a work to be known as 'Trees and Shrubs' and to consist of illustrations and brief descriptions of new and little-known trees and shrubs, chiefly from material obtained from the Arnold Arboretum. It will not be confined wholly to North American plants, but 'will include also the woody plants of other regions, especially those of the northern hemisphere, which may be expected to flourish in the gardens of the United States and Europe, and those of special commercial or economic interest and value.' It is to be published at irregular intervals, and each part will contain twenty-five plates. It is the hope of the publishers that one part will appear in the fall of 1901, and that at least two parts may be issued each year. From the specimen plates and pages of text it is evident that this is to be a work second only to the 'Silva' in importance and value to working botanists and horticulturists.

THE OAKS OF THE CONTINENTAL DIVIDE.

BOTANISTS who have puzzled over the little oak trees of the Pike's Peak region in Colorado will be interested in a paper by Dr. Rydberg in a *Bulletin of the New York Botanical Garden* (Vol. II., No. 6), in which he attempts to bring something like order out of the chaotic condition which has existed hitherto. After several seasons of field work in the Rocky Mountains, Dr. Rydberg finds that the Colorado oaks heretofore referred to *Quercus undulata* and *Q. gambelii* are more properly to be referred to ten or eleven species, three of which prove to have been undescribed. About Pike's Peak there are no less than six species, instead of the single species *Q. undulata;* these are *Q. utahensis, Q. leptophylla* (new), *Q. gunnisonii, Q. nitescens* (new), *Q. novo mexicana* and *Q. gambelii.* Dr. Rydberg found it necessary to extend his studies throughout the mountain region, and as a result he has very considerably enlarged the list of species for this portion of the continent. His descriptive list includes no less than twenty-nine names, of which the new species are: *Q. submollis* (Arizona), *Q. vreelandii* (Colorado to New Mexico), *Q. leptophylla* (Colorado), *Q. nitescens* (Colorado to Utah), *Q. eastwoodiæ* (Utah), *Q. havardi* (Texas), *Q. pauciloba* (Arizona), *Q. wilcoxii* (Arizona to Utah and Nevada).

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

CONFERRING OF DEGREES AT THE UNIVERSITY OF CHICAGO.

As we have already recorded, the University of Chicago conferred in connection with its decennial eleven honorary degrees. President Harper, in welcoming the men of science on whom the LL.D. degree was conferred, spoke as follows:

Edward Charles Pickering,

during twenty-five years Payne Professor of Astronomy and Director of the Astronomical Observatory of Harvard College, an observatory developed through your labors into an institution foremost in research on two continents; organizer in the United States of a system of laboratory teaching of great influence on education in physical science; student of optics; discoverer of variable stars and investigator in stellar photometry; originator of many astronomical applications of photography and spectroscopy, which have revealed the constitution of the stellar universe:—for these distinguished services, and especially for the last-named, by the authority of the Board of Trustees of the University of Chicago, upon nomination of the University Senate, I confer upon you the degree of Doctor of Laws of this University, with all rights and privileges appertaining thereunto.

Jacob Henry van't Hoff,

Professor of Physical Chemistry in the University of Berlin, investigator who has brought to bear upon chemical problems a keen and logical mind, endowed with speculative and imaginative powers of the highest order, founder of the theory explaining the space relations of atoms in molecules—a theory which is essential to a comprehension of the chemistry of organized and inorganized matter; master in the field of dynamic chemistry; investigator and brilliant discoverer in the domain of the modern theory of solutions, a theory which constitutes one of the greatest advances made by chemical science in the last quarter of a century:—for these splendid and fertile achievements, by the authority of the Board of Trustees of the University of Chicago, upon nomination of the University Senate, I confer upon you the degree of Doctor of Laws of this University, with all the rights and privileges appertaining thereunto.

Charles Doolittle Walcott,

Director of the United States Geological Survey, Superintendent of the National Museum, author of

numerous paleontological and geological contributions of eminent merit, notable among which are a series of monumental works on the Cambrian System of North America: for these distinguished contributions, and for signal ability displayed in the administration of the scientific and educational interests committed to your charge, by the authority of the Board of Trustees of the University of Chicago, upon the nomination of the University Senate, I confer upon you the degree of Doctor of Laws of this University, with all the rights and privileges appertaining thereunto.

Edmund Beecher Wilson,

Professor of Zoology in Columbia University, zoologist and worker in the field of biology, teacher and leader of many young investigators, writer of standard text-books in general biology and of numerous philosophical essays and classical memoirs on zoology; author of a masterpiece of research and presentation, 'The Cell in Development and Inheritance,' which embodies the writer's original contributions in embryology and cytology, as well as the results reached by other workers in these fields—for these eminent services in science, especially for the work last named, by the authority of the Board of Trustees of the University of Chicago, upon the nomination of the University Senate, I confer upon you the degree of Doctor of Laws of this University, with all the rights and privileges appertaining thereunto.

THE AMERICAN PHILOSOPHICAL SOCIETY.

The American Philosophical Society, at its meeting on May 17, adopted the following resolution:

Whereas, The American Philosophical Society is and always has been a society of national scope, whose place of meeting was originally fixed at Philadelphia for reasons of convenience now less potent than formerly; and

Whereas, The growth and wide extent of our country and the multiplication of local societies tends to keep from our regular meetings those members who do not reside within a short distance of Philadelphia; and

Whereas, It is desirable that measures be taken to bring the distant members into more active participation in the work of the Society; therefore be it

Resolved, (1) That a committee of five be appointed by the President to consider the advisability and, if deemed advisable, to arrange for a general meeting at a time most convenient to all the members;

(2) That this meeting shall cover one or more days as may be considered advisable, and it is hoped that the high scientific character and broad interest of the papers to be presented shall insure the attendance of a good proportion of distant members;

(3) That this committee shall have power to add to its number and to make all necessary arrangements to further the success of the proposed general meeting.

The committee appointed, consisting of Professors George F. Barker, Chairman, Edwin G. Conklin, Charles L. Doolittle, William B. Scott, William Powell Wilson, has enlarged its number, and has asked for suggestions which will tend to promote the success of the proposed general meeting. It is suggested that the meeting be held on the Friday and Saturday following Thanksgiving Day, on the Friday and Saturday following New Year's Day, or in Easter week.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

ADDITIONS AND CORRECTIONS TO THE PRELIMINARY ANNOUNCEMENT.

The preliminary announcement of the Denver meeting of the Association has been mailed to all members, and it will undoubtedly have been noticed that the question of railroad rates has been left incomplete, except for the announcement of the Western Passenger Association, the statement being made that further arrangements will be announced in Science. The following arrangements have been made: *The Western Passenger Association*, covering the territory *west* of Chicago and St. Louis, has made a rate of one fare plus $2 for the round trip, from all points in their territory to Denver, tickets to be sold July 10 to August 31, with final return limit of October 31.

The New England, Trunk Line, Central and Southeastern Passenger Associations, covering the territory *east* of Chicago and St Louis, have made a rate of a fare and one-third for the round trip from all points in their territory to Denver, on the certificate plan, the conditions of which are as follows:

1st. Each person desiring to avail himself of the reduced rate must purchase a first-class ticket (either limited or unlimited) to the place of meeting, at the regular tariff rate and at the same time procure from the ticket agent a certificate of the standard form. If through ticket cannot be procured at the starting

point, the person should purchase to the most convenient point at which such ticket can be obtained and there repurchase through to the place of meeting, *procuring a standard certificate from each agent from whom a ticket is purchased.*

2d. *It is absolutely necessary that certificates be procured, indicating that the full fare has been paid for going passage and the route for which ticket or tickets for the return journey should be sold. No refund of fare can be expected because of failure to secure such certificates.*

3d. Tickets for the return journey will be sold at one-third the first-class tariff fare only to persons holding certificates of the standard form duly signed by the Permanent Secretary of the A. A. A. S., and signed by the special agent appointed for that purpose.

4th. No certificate will be honored that was procured more than three days (Sunday not included) before the meeting assembles (except that when meetings are held at distant points to which the authorized transit limit is more than three days, the authorized transit limit will govern), nor more than two days (Sunday not included) after the first day of the meeting. No certificate will be honored for return ticket unless presented during the time that the meeting is in session, or within three days (Sunday not included) after adjournment.

5th. Tickets for return journey will be limited to continuous passage on first train after purchase.

6th. Certificates will not be honored by conductors; they must be presented to ticket agents.

7th. Neither the certificates nor tickets furnished for this occasion are transferable, and if presented by any other person than the original purchaser, they will not be honored but will be forfeited.

Members desiring longer time than that allowed in connection with certificate reduction, viz., 3 days before the meeting assembles to 3 days after adjournment (Sunday not included) are advised to take advantage of the Colorado tourist fares or summer excursions, which, while costing a little more than the fare and one-third, are good from July 10 to October 31.

CORRECTION TO PROGRAM OF MONDAY AFTERNOON, AUGUST 26.

(See page 26 of the preliminary announcement.)

Through some clerical or printer's blunder the vice-presidents elect are here announced to give their addresses at 3 o'clock at the high-school building. As a matter of fact, this is all wrong. The vice-presidential addresses which will be given are those of four of the retiring vice-presidents, as follows:

Vice-President Brashear, before the Section of Mechanical Science and Engineering.

Vice-President Davenport, before the Section of Zoology.

Vice-President Butler, before the Section of Anthropology.

Vice-President Woodward, before the Section of Social and Economic Science.

It will probably be arranged so that two of these addresses will be given at 3 o'clock and two at 4 o'clock, in order to allow members interested to hear two addresses.

THROUGH PULLMAN SERVICE.

If a sufficient number of passengers can be guaranteed, arrangements can be made for through Pullman service, to connect at Chicago or St. Louis, so that members from different sections of the country can make the trip to Denver together. The Permanent Secretary therefore invites all members who plan to attend the meeting and who wish to take advantage of this through Pullman service to communicate with him at once, stating the name of the road over which they intend to travel and the date of their departure. If a sufficient number of replies are received, the arrangement will be made and members notified.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR JAMES DEWAR, the eminent chemist, has been elected president of the British Association to follow Professor A. W. Rücker, and will preside at the Belfast meeting in 1902.

OXFORD UNIVERSITY has conferred its D.Sc. on Philip Lutley Sclater, M.A., F.R.S., secretary of the Zoological Society, London, and its D.C.L. on C. N. Dalton, C.B., comptroller-general of patents, designs and trade-marks.

DR. JOHN S. BILLINGS, director of the New York Public Library, has been elected president of the American Library Association.

M. MAUPAS has been elected a correspondent of the Paris Academy of Sciences in the

section of anatomy and physiology, replacing the late M. Marion.

The following have been appointed members of the visiting committee of the National Bureau of Standards: Dr. Ira Remsen, president, Johns Hopkins University; Professor Elihu Thomson, electrician, General Electric Company; Professor E. L. Nichols, professor of physics, Cornell University; Dr. Henry S. Pritchett, president, Massachusetts Institute of Technology; Mr. Albert Ladd Colby, metallurgical engineer, Bethlehem Steel Company, and secretary of the Association of American Steel Manufactures. Professor E. B. Rosa, of Wesleyan University, has been appointed physicist.

Dr. Henry Woodward, F.R.S., keeper of the Department of Geology of the British Museum (Natural History), will retire in November, having some time since reached the age limit. It is expected that he will be succeeded by Dr. Arthur Smith Woodward, F.R.S., under whom the department would certainly be administered in accordance with the best scientific methods. Dr. Woodward's visit to this country last year is remembered with great pleasure by many American men of science.

Professor C. Le Neve Foster, of the Royal School of Mines, London, has resigned the position of inspector of mines, which he has held for the past twenty-eight years.

We regret to learn that Professor Rudolf Virchow has met with an accident, cutting his head by a fall, on June 13. His health has for some time past not been very good. Professor Virchow will celebrate his eightieth birthday on October 13.

Professors David Hilbert (Göttingen), Georg Cantor (Halle) and Ulisse Dini (Pisa) have been elected foreign members of the London Mathematical Society.

J. W. Lowber, Ph.D., F.R.G.S., Austin, Texas, has been elected a fellow of the Royal Meteorological Society of London.

The Belgian quinquennial jury of medical sciences has awarded its prize of the value of 5,000 francs to Professor Van Gehuchten of Louvain, for his researches on the brain and spinal cord.

Professor J. H. Ames, of the Johns Hopkins University, has accepted the position of associate editor of the *American Journal of Science* held by the late Professor H. A. Rowland.

Dr. R. A. Daly has resigned his place as instructor of physiography at Harvard University to accept a position on the Geological Survey of Canada, where he will be attached to the party that is marking the international boundary on the Pacific slope. Mr. A. W. G. Wilson, who has just received the degree of Doctor of Philosophy in geology at Harvard, has also been appointed to the Canadian Survey for work in the country about Lake Nipigon.

George G. Hedgcock, B.Sc., 1899, and A.M., 1901, of the University of Nebraska, and sometime fellow in botany, has been appointed by the United States Department of Agriculture to investigate the diseases of the sugar beets of Nebraska and other western states.

Professor John B. Johnson, dean of the College of Mechanics and Engineering of the of the University of Wisconsin, opened the discussion on present tendencies in technical and professional education at the twenty-ninth annual Convocation of the University of the State of New York, held at Albany last week.

At a meeting of the Western Society of Engineers on June 26, Professor B. E. Fernow, of the New York State College of Forestry, delivered an address on 'The Relation of Forestry to Engineering.'

A committee has been formed to erect in Bern a memorial to the great anatomist and physiologist Albrecht v. Haller, who was born in Bern in 1708 and died there in 1777.

Dr. John Fiske, the well-known lecturer and author, died on July 4 after a short illness caused by the excessive heat. Born in 1842, he graduated from Harvard University in 1863 and was for a time connected with the University as lecturer on philosophy and later as assistant librarian. Fiske did much by his books, lectures and articles to popularize the doctrine of evolution, especially on the lines laid down by Mr. Herbert Spencer. His 'Out-

lines of Cosmic Philosophy,' published in 1874, was followed by a long series of books, his contributions to history being in large measure influenced by his earlier work on evolution. Fiske enjoyed the personal friendship of Darwin, Huxley, Spencer and other great leaders, and the esteem of a large section of the general public.

PROFESSOR PETER GUTHRIE TAIT, who has held for the past forty years the chair of natural philosophy in Edinburgh University, died at Edinburgh on July 4. Born at Dalkeith in 1831, he attended Edinburgh University, and afterwards Cambridge University, where he was senior wrangler, first Smith's prizeman and fellow of Peterhouse. In 1854 he became professor of mathematics at Queen's College, Belfast, whence he removed to Edinburgh in 1860. He was the author of a long series of publications, both technical and popular in character. These include the 'Dynamics of a Particle,' 'Quaternions,' 'Thermodynamics,' and works on 'Heat,' 'Light' and 'The Properties of Matter.' His scientific papers were collected and published in 1898. In conjunction with Professor Balfour Stewart, he was the author of 'The Unseen Universe,' and, in cooperation with Lord Kelvin, prepared the well-known 'Natural Philosophy' of Thomson and Tait.

DR. THEODORE GREELY WHITE died in New York city on July 7, aged twenty-nine years. After having graduated from the School of Applied Sciences of Columbia University, he received the Ph.D. degree two years ago for work in geology. He was also assistant in the department of physics. Dr. White had made valuable contributions to geology and botany, and leaves a considerable amount of unpublished material. He was always active in good work, being last year one of the secretaries of the New York Academy of Sciences and acting editor of the publications of the academy.

THE small band of New Mexico naturalists has suffered a severe loss by the death of Mr. Francis J. Birtwell, of Albuquerque, who had spent two years investigating the ornithology of the territory, and who had in preparation an elaborate paper on the birds of New Mexico. Mr. Birtwell was married on May 24, and went with his wife to study the birds of the Upper Pecos. On June 28, at Windsor's Ranch, 31 miles from Glorieta, he climbed a tall fir tree to obtain a bird's nest. Becoming dizzy, he signalled for help, and was being let down on a rope when by some means he jerked one arm out of the noose, and the rope tightened around his neck and strangled him before anyone could come to his assistance. Thus perished a man who was expected by those who knew his work to take a prominent place among American ornithologists. It is understood that his manuscript on the birds of New Mexico is in good order, and it is much to be hoped that the means will be found for its publication.

DR. JOHN CURWEN, a specialist in mental diseases, who for fifty years has been superintendent of hospitals for the insane at Harrisburg and Warren, Pa., died on July 2, aged eighty years.

MR. JOHN H. TEGMEYER, a well-known civil engineer, died at Baltimore on July 4, aged eighty years.

PROFESSOR LANGENBUCH, the eminent surgeon, director of the Lazarus Hospital, Berlin, died on June 9.

THE late Jacob S. Rogers, of Paterson, N. J., a locomotive builder, has bequeathed nearly his entire estate to the Metropolitan Museum of Art, New York City. The value of the bequest is estimated at from $6,000,000 to $8,000,000.

MR. ANDREW CARNEGIE has offered to give to the cities of San Francisco and Detroit $750,000 for the establishment of public libraries.

THE Newberry Library, of Chicago, has acquired the philological library collected by the late Louis Lucien Buonaparte. It contains 15,000 volumes and is said to be the best philological library in the world.

IN connection with the census of India, a sum of at least £10,000 will be spent in collecting statistics relating to ethnology and anthropology.

A MAGNIFICENT specimen of the elephant seal (*Macrorhinus leoninus*) from the Macquarie Islands has lately been presented to the British Museum by the Hon. Walter Rothschild, one

of the trustees. The skin has been stuffed by Messrs. Gerard, who have imparted to the animal with its enormous fleshy nose a most lifelike, not to say human, appearance.

PLANS have been made to collect funds for a research scholarship at Trinity College, Dublin, in memory of the late Professor G. F. Fitzgerald.

AN anatomical museum fund, in memory of the late A. H. Hughes, who died in South Africa, has been established in connection with University College, Cardiff. Mrs. Hughes, the widow of Professor Hughes, has contributed £1,000 to this fund.

The deaths from the plague in Cape Colony to June 8 have numbered: Europeans, 58; colored persons, 164; Malays, 36; Indians, 9; Chinese, 0; natives, 59; total, 326. Only one case has occurred under naval and military control.

THE National Bureau of Standards was opened on July 1, with headquarters in the building of the Coast and Geodetic Survey. Plans are being prepared for the new building, for which Congress has made provision.

IT is expected that the new Horticultural Building in Boston will be completed by the end of August, when there will be a special exhibition, arranged by Professor Charles S. Sargent, of the Arnold Arboretum.

THE observatory at Nice and its branch on Mt. Mourier has recently been visited by the board of control, consisting of MM. Gréard, Henri Poincaré, Barrot, Cornu, Lippmann, Lœwy, Darboux, Mascart, Troost, Bischoffsheim.

THE Philippine Commission has established a government biological and chemical laboratory at Manila, which will have branch stations elsewhere. A superintendent will be appointed with a salary of $4,000. A board of health has been established with a commissioner with a salary of $6,000.

The Navy Department has purchased a tract of land surrounding the naval observatory, in order to protect the instruments. It was deemed advisable not to have any highways within 1,000 feet of the clock room, where the instruments are stationed, and a circle with a radius of 1,000 feet was therefore drawn round the observatory. At the last session of Congress $145,000 was appropriated to purchase the inclosed land, and of this sum $122,000 has been expended for the purchase of about sixteen acres.

DR. C. W. ANDREWS, assistant in the Department of Geology, British Museum, Natural History, has been making collections in Egypt, which he has this month brought back with him to London.

THE expedition, planned by the South Dakota Geological Survey, into the Grand River region for this season has been postponed, because of smallpox in the Indian reservations where much of the work would have been done. It is hoped that next year circumstances will be more favorable.

THE Southeastern Union of Scientific Societies (England) held its sixth annual congress at Haslemere and Hindhead last month, under the presidency of Mr. G. A. Boulenger, F.R.S. The congress next year will be held at Canterbury, under the presidency of Dr. Jonathan Hutchinson, F.R.S.

WE learn from *Nature* that a committee has recently been appointed by the Institution of Civil Engineers, with the support of the Institutions of Mechanical Engineers and Naval Architects and of the Iron and Steel Institute, to consider the advisability of standardizing the various kinds of iron and steel sections, and, if found advisable, then to consider and report as to the steps which should be taken to carry such standardization into practice.

THE civil service commission reports that no applications have been received for the examination which was to have been held on July 6 for the position of laboratory assistant in physics at the national bureau of standards, as announced in this Journal several weeks ago. There are two vacancies to be filled as a result of this examination, one paying $1,200 and the other $1,400 a year. These openings are extremely desirable, as the work is largely research and the way is open for promotion.

THE civil service commission announces that it is desired to establish an eligible register

for the position of assistant physicist. It will not be necessary for applicants to appear at any place for examination. The examination will consist of the subjects mentioned below which will be weighted as follows:

Subjects.	Weights.
Education and training, with particular reference to the subjects of mathematics and chemistry	20
Experience in general laboratory manipulation, including glass-blowing, photography and assembling and making apparatus	10
Experience in advanced quantitative measurements, including determination of physical constants, comparison with standards, etc	20
Experience in original experimental research, particularly that relating to the physics of solutions and of finely divided solids. (In connection with this subject will be considered the various theses of published papers concerning investigations or experiments which the applicant has directed or assisted in)	40
Training in mathematical physics. (This subject will include the consideration of theses of published papers on this line of work)	10

From the eligibles resulting from this examination it is expected that certification will be made to the position of assistant physicist, Bureau of Soils, Department of Agriculture, at a salary of $1,600 per annum, and to other similar vacancies as they may occur.

WE learn from the *Electrical World* that *L'Eclairage Electrique* is organizing a technical excursion to the United States to visit the Pan-American Exhibition in Buffalo, and to attend at the same place the convention in August of the American Society of Electrical Engineers. The party will leave Paris Aug. 3, arrive at New York Aug. 11, and leave for Philadelphia the same day. Aug. 13 will be spent in Washington, and the party will remain in New York from the 14 to the 18. The program from the 18 to the 26 coincides with that of the American Institute of Electrical Engineers. From Buffalo the party will go to Chicago, and from that city by way of the Lakes and the St. Lawrence River to Montreal and Quebec, returning to New York on Sept. 3, and sailing from the latter city Sept. 5.

CONCERNING the influence of chemical transformation on weight, Lord Rayleigh writes to *Nature* as follows: Careful experiments by Heydweiller, published in the last number of Drude's *Annalen* (Vol. V., p. 394), lead their author to the conclusion that in certain cases chemical action is accompanied by a minute, but real, alteration of weight. The chemical actions here involved must be regarded as very mild ones, *e. g.*, the mere dissolution of cupric sulphate in water, or the substitution of iron for copper in that salt. The evidence for the reality of these changes, which amount to 0.2 or 0.3 mg., and are accordingly well within the powers of a good balance to demonstrate, will need careful scrutiny; but it may not be premature to consider what is involved in the acceptance of it. The first question which arises is: Does the *mass* change as well as the *weight?* The affirmative answer, although perhaps not absolutely inconsistent with any well-ascertained fact, will certainly be admitted with reluctance. The alternative—that mass and weight are not always in proportion—involves the conclusion, in contradiction to Newton, that the length of the seconds' pendulum at a given place depends upon the material of which the bob is composed. Newton's experiment was repeated by Bessel, who tried a number of metals, including gold, silver, lead, iron, zinc, as well as marble and quartz, and whose conclusion was that the length of the seconds' pendulum formed of these materials did not vary by one part in 60,000. At the present day it might be possible to improve even upon Bessel, or at any rate to include more diverse substances in the comparisons; but in any case the accuracy obtainable would fall much short of that realized in weighings. As regards Heydweiller's experiments themselves, there is one suggestion which I may make as to a possible source of error. Is the chemical action sufficiently in abeyance at the time of the first weighing? If there is copper sulphate in one branch of an inverted U and water in the other, the equilibrium can hardly be complete. The water all the time tends to distil over into the salt, and any such distillation must be attended by thermal effects which would interfere with the accuracy of the weighing.

UNIVERSITY AND EDUCATIONAL NEWS.

After a long discussion of the report of the committee on 'A National University,' published above, the national council of education passed on July 9 the following resolution:

Resolved, That the report of the committee be received and the committee discharged; and that while we express our appreciation of their labors we are not prepared to abandon the position taken by the National Educational Association in favor of a National University.

At the Johns Hopkins University the following promotions have been made:

Henry F. Reid, Ph.D., now associate professor, to be professor of geological physics.

William J. A. Bliss, Ph.D., now associate, to be collegiate professor of physics.

Duncan S. Johnson, Ph.D., now associate, to be associate professor of botany.

Oliver L. Fassig, Ph.D., now instructor, to be associate in meteorology.

Charles R. Bardeen, M.D., now associate, to be associate professor of anatomy.

Thomas B. Futcher, M.B, now associate, to be associate professor of medicine.

Walter Jones, Ph.D., now associate, to be associate professor of physiological chemistry.

Robert L. Randolph, M.D., now associate, to be associate professor of ophthalmology and otology.

Stewart Paton, M.D., now assistant in neurology, to be associate in psychiatry.

Percy M. Dawson, M.D., now instructor, to be associate in physiology.

Eugene L. Opie, M.D., now instructor, to be associate in pathology.

Frank R. Smith, M.D., now instructor, to be associate in medicine.

Henry B. Jacobs, M.D., now instructor, to be associate in medicine.

Thomas McCrae, M.B., now instructor, to be associate in medicine.

Frank W. Lynch, M.D., now assistant, to be associate in obstetrics.

At Washington University, St. Louis, Mr. Alexander S. Chessin, formerly associate professor of mathematics in the Johns Hopkins University, has been appointed professor of mathematics to succeed Professor Edmund A. Engler, now president of Worcester Polytechnic Institute. Alexander S. Langsdorf, graduate of Washington University, was appointed assistant professor of electrical engineering. It is announced that before the beginning of next term, a professor of zoology and a professor of philosophy will be appointed.

Joseph Marshall Flint, Ph.D. (Johns Hopkins), instructor in the University of Chicago, has been appointed to the newly established chair of anatomy in the University of California.

C. W. Marx, professor of mechanical engineering in the University of Missouri, has accepted the professorship of engineering in the University of Cincinnati.

Dr. Frederic E. Clements, of the University of Nebraska, has been promoted from an instructorship to the adjunct professorship of botany. Dr. Clements is conducting a summer school of ecological botany in the Pike's Peak region in the Rocky Mountains of Colorado. About twenty students are registered for the work.

John James Thornber, B.Sc., 1897, and M.A., 1901, of the University of Nebraska, for several years teacher of science in the High School of Nebraska City, Nebr., and special botanical collector for the University of Nebraska for the present season, has been elected to the professorship of botany in the University of Arizona. He will assume his new duties on August 1, after which his address will be Tucson, Arizona.

Miss Minnie A. Stoner, dean of the Woman's Department and professor of domestic science in the Kansas State Agricultural College, has been elected professor of domestic science in the Ohio State University.

The place left vacant in the State Normal School at Charleston, Ill., by the resignation of Dr. J. Paul Goode to accept the position of instructor of geography in the University of Pennsylvania, has been given to Mr. G. D. Hubbard, graduate of the University of Illinois and M.A., Harvard.

Mr. W. V. B. Van Dyck has resigned an instructorship in electrical science in Rutgers College, to engage in industrial work.

Sir Martin Conway, known to scientific men for his explorations in the Himalayas, in Spitzbergen and in the Andes, has been made professor of fine arts in Cambridge University.

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JOSEPH LE CONTE, the most honored and beloved of American men of science, professor of geology and natural history in the University of California, the author of important contributions to geology, natural history, psychology and education, president in 1892 of the American Association for the Advancement of Science, president in 1896 of the Geological Society of America, one of the editors of this Journal, died in the Yosemite Valley, on July 6, at the age of eighty-eight years.

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